SUMMER INTERNSHIP REPORT

on

Saline Level Detector for Hospital Management

Duration: June 24, 2024 to August 2, 2024

Under Supervision Of

Ms. Ankita Sarkar, USICT, GGSIPU

Mr. Saravjot Singh, GoGlobalWays

Submitted By:

Name	**Name of College**
Arjun Lakhanpal	BPIT, GGSIPU
Samarth Khanna	BPIT, GGSIPU
Tanisha	FOT, DU

E-Block Lab, Guru Gobind Singh Indraprastha University
Sector-16C, Dwarka, Delhi - 110078
July, 2024

Certificate

This is to certify that the internship project entitled

”Saline Level Detector for Hospital Management”

was successfully completed by the following students from various colleges in partial fulfilment of the requirements for the award of the degree under the internship program at AICTE IDEA Lab-Guru Gobind Singh Indraprastha University New Delhi - 110078.

1. Arjun Lakhanpal BPIT, GGSIPU
2. Samarth Khanna BPIT,GGSIPU
3. Tanisha FOT, DU

Mentors:

1. Mr. Sourabh Anand

   Department of AICTE Lab, GGSIPU

Date: July 31, 2024

Declaration

We hereby declare that the project work presented in this internship report, entitled **”Saline Level Detector for Hospital Management”** is entirely our own work and has not been submitted for any degree or diploma from this or any other institute for partial fulfilment of the requirements for the award of the degree.

1. Arjun Lakhanpal BPIT, GGSIPU
2. Samarth Khanna BPIT, GGSIPU
3. Tanisha FOT, DU

Acknowledgement

We would like to express our gratitude to our college, University School of Information, Communication & Technology, Guru Gobind Singh Indraprastha University, for providing us with the opportunity to participate in this internship program during the summer. Their encouragement has been of great significance to our development.

We would also like to express gratitude to AICTE IDEA Lab-Guru Gobind Singh Indraprastha University, E-Block, Guru Gobind Singh Indraprastha University Sector-16C, Dwarka, New Delhi - 110078, for arranging the internship and providing us the opportunity to take part in it. The knowledge and experience that we have obtained from our time spent here have been really beneficial.

We would like to express our gratitude to our mentors, Mr. Sourabh Anand, for providing direction, support, and constructive criticism. We would not have been able to complete this assignment without his assistance. He also informed me about this great platform called Google Colab, which has been a saviour while working remotely.

I would also like to extend my heartfelt gratitude to the members of my team, Arjun Lakhanpal & Samarth Khanna from BPIT, GGSIPU, and Tanisha Bageshwari from FOT, DU for their unwavering support and collaborative efforts. It has been a rewarding experience to collaborate with each and every one of you.

We would like to express our gratitude to everyone else who assisted us throughout this internship. For their assistance, we would like to extend special gratitude to Dr. Reena Gupta and Prof. Amit Prakash Singh. Their assistance has been of extreme value.

Our heartfelt thanks to Ms. Heena Kalim, who encouraged us to switch to LaTeX and helped us with its basics. Thanks to her guidance, we are now able to write this entire report in LaTeX by ourselves.

Abstract

The project ”Saline Level Monitoring for Hospital Management System” aims to enhance the efficiency and reliability of saline level monitoring in hospital environments. Continuous monitoring of saline levels is crucial for ensuring optimal patient care, as deviations can lead to complications and affect treatment outcomes. Traditional methods of monitoring are often manual and prone to errors, resulting in potential risks to patient safety and increased workload for healthcare professionals.

In this project, we propose a system that utilizes advanced sensor technology and automated data processing techniques to monitor saline levels in real-time. The system integrates sensors with a hospital management software platform, allowing healthcare providers to monitor saline levels remotely and receive timely alerts for any deviations from predefined thresholds. This automated approach not only improves the accuracy and reliability of saline level monitoring but also reduces the burden on healthcare staff, allowing them to focus more on patient care.

The implementation of the proposed system involves sensor deployment, data integration, and software customization tailored to the specific needs of hospital environments. A pilot study conducted in a hospital setting demonstrates the feasibility and effectiveness of the system in enhancing operational efficiency and patient safety. The project outcomes highlight the potential of technology-driven solutions to transform healthcare delivery and improve patient outcomes.

Keywords: Saline Level Monitoring, Hospital Management System, Sensor Technology, Automated Monitoring, Healthcare Efficiency.

Contents

1 Introduction

The Internet of Things (IoT) is a network of physical objects that comprise various devices, vehicles, buildings, and other items embedded with electronics, software, and sensors, enabling these objects to collect and exchange data amongst each other. The Internet of Things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems.

In the healthcare sector, constant monitoring of patients receiving intravenous saline is crucial. Whenever saline is administered, patients require continuous observation by nurses or relatives. However, due to factors such as negligence, inattentiveness, busy schedules, and high patient volumes, nurses may forget to change the saline bottle as soon as it is completely consumed. This oversight can have serious consequences: as the saline runs out, blood pressure differences can cause blood to rush back into the saline bottle. This reverse flow of blood can lead to a reduction in haemoglobin levels and, in severe cases, a shortage of red blood cells (RBCs) in the patient's blood, resulting in fatigue and other health complications.

To address this issue, there is a pressing need to develop a saline level monitoring system that reduces patient dependency on nurses or caregivers. This IoT-based automatic alerting and indicating device utilizes an infrared (IR) sensor as a level sensor. The output voltage from the IR sensor changes when the intravenous fluid level falls below a certain threshold. A comparator continuously monitors the IR output against predefined thresholds. When the fluid level is identified as too low, the Arduino controller triggers an alert, notifying the observer through a web page or app.

When the saline level drops to a critical point, a notification is generated to inform the nurse that the saline administered to the patient is depleted. The system also utilizes weight measurement to determine the amount of saline present in the bottle, enabling the provision of data on a smartphone-based app or computer-based web page accessible from the nurse’s station. If the nurse fails to attend to the alert immediately, a mechanism is activated to block the saline tube, preventing the upward flow of saline from the veins back into the bottle.

This innovative approach aims to enhance patient safety and streamline hospital operations, ultimately contributing to better healthcare outcomes.

2 System Design

2.1 Hardware Components

2.1.1 GSM SIM 800L:

The GSM 800L module is a powerful GSM/GPRS module that allows communication over mobile networks. It is used for sending and receiving SMS messages and for establishing voice calls in IoT applications. The GSM 800L is compact and cost-effective, making it suitable for various embedded systems.

This module operates at a voltage range of 3.4V to 4.4V, making it compatible with most microcontroller platforms, including the Arduino. The GSM 800L module supports various communication protocols, including UART, which facilitates easy integration with microcontrollers. It features a built-in antenna connector for enhanced signal strength and range.

One of the key benefits of the GSM 800L is its ability to send alerts and notifications to healthcare providers in real-time, ensuring immediate attention when a saline bottle is about to run out. This capability is crucial in critical care situations where timely intervention can significantly impact patient outcomes. The GSM module can also be used to log data remotely, enabling better management of hospital resources.

Figure 2.1.1: GSM SIM 800L

2.1.2 Arduino Uno Rev3:

The Arduino Uno Rev3 is a popular microcontroller board used in electronics projects and prototyping. It features an ATmega328P microcontroller and is designed to be user-friendly, making it accessible for both beginners and experienced developers. The board includes 14 digital I/O pins, 6 analog input pins, and a 16 MHz crystal oscillator, which provide a robust foundation for creating various electronic circuits and applications.

The Rev3 model includes improvements over previous versions, such as better compatibility with shields and more reliable USB communication. It has a built-in LED on pin 13 for simple debugging and includes an external power jack that allows it to be powered by an external 7-12V power supply, in addition to USB power.

Programming the Arduino Uno is straightforward through the Arduino IDE, which supports a variety of libraries and example sketches to help users get started quickly. The board also features a reset button and an ICSP header for advanced programming techniques. Its versatility and ease of use make it a go-to choice for prototyping and educational projects in electronics and robotics.

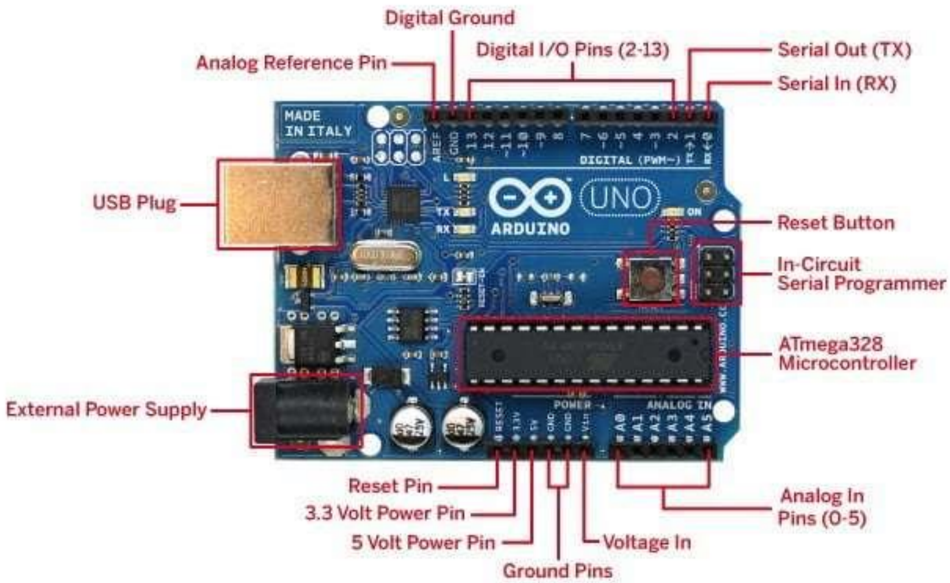


Figure 2.1.2: Arduino Uno Rev3

2.1.3 HX711 Sensor

The HX711 is a dual-channel, 24-bit precision A/D weight pressure sensor load cell amplifier and ADC module. It is a small breakout board for the HX711 IC, allowing easy reading of load cells to measure weight. By connecting the module to a microcontroller, users can read changes in the resistance of the load cell and, after calibration, obtain accurate weight measurements. This module is useful for creating industrial scales, process control systems, or simple presence detection. The HX711 uses a two-wire interface (Clock and Data) for communication, making it compatible with most microcontrollers' GPIO pins. Numerous libraries have been developed, simplifying the process of reading data from the HX711.

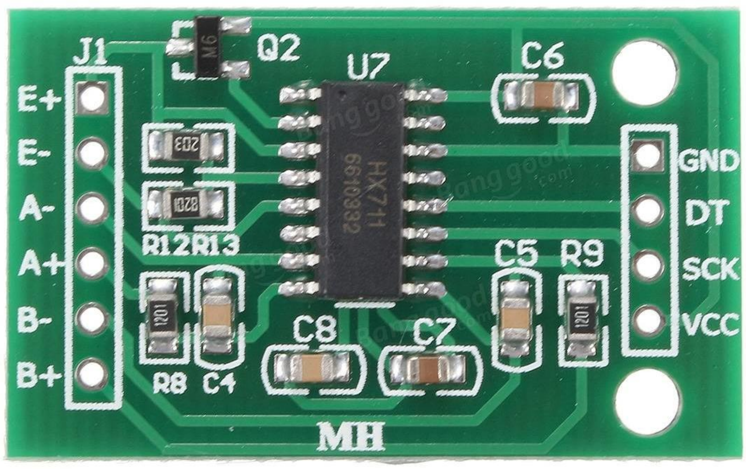
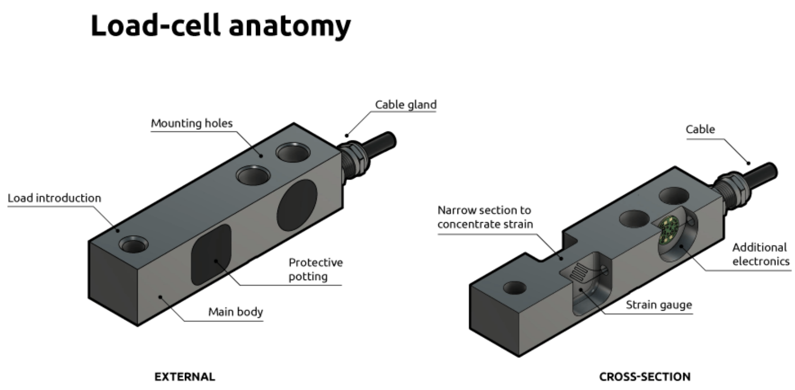


Figure 2.1.3: HX711 Sensor

2.1.4 Load Cell

The load cell used in this project serves as a weight sensor with a rated load capacity of 5 kg and a maximum working voltage of 15 V DC. It is positioned on the medical intravenous system, with the saline bottle suspended on the load cell. This strain gauge load cell converts the saline weight into electrical signals, which are then sent to the weight sensor amplifier module (HX711) before being processed by the microcontroller.



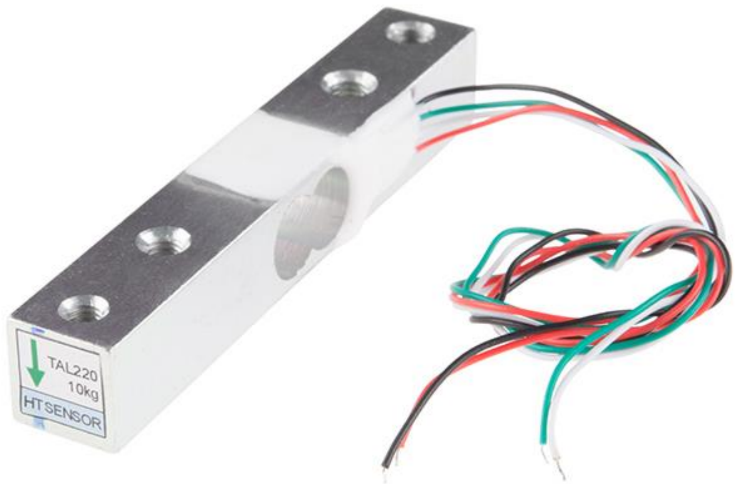


Figure 2.1.4: Load Cell

2.2 Software Components

2.2.1 Arduino IDE

The Arduino Integrated Development Environment (IDE) is a user-friendly software platform that facilitates the programming and development of Arduino microcontroller-based projects. Arduino, an open-source electronics platform, has gained widespread popularity among hobbyists, students, and professionals due to its simplicity and versatility. The Arduino IDE provides a comprehensive environment for writing, compiling, and uploading code to Arduino boards. It supports a simplified version of the C++ programming language, making it accessible even for those with minimal programming experience. The IDE includes a code editor with syntax highlighting, a compiler, and a serial monitor for debugging and communication with the Arduino board. Additionally, the Arduino IDE is compatible with various Arduino boards, allowing users to seamlessly switch between different hardware configurations. Its user-friendly interface and extensive community support make it an ideal choice for individuals looking to explore and experiment with electronics and programming.

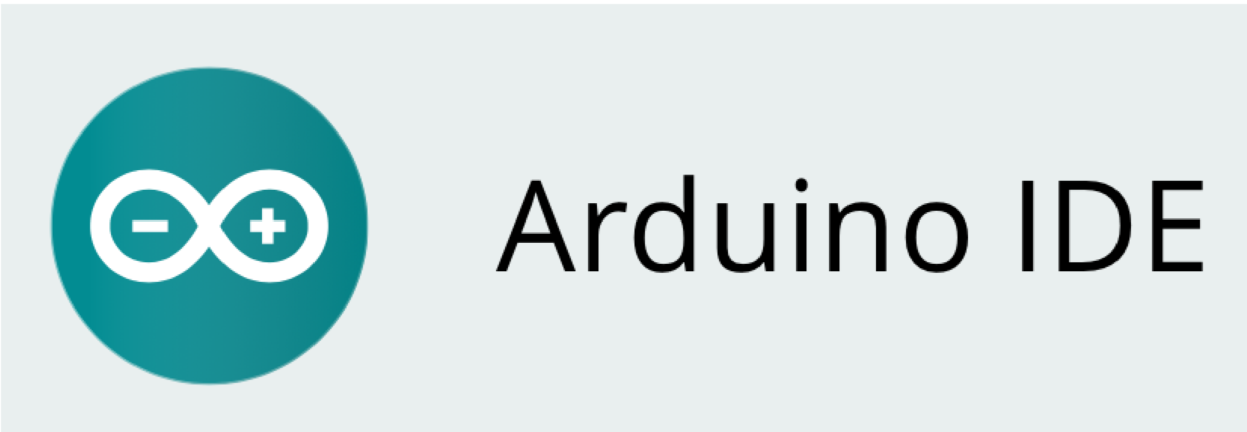


Figure 2.2.1: Arduino IDE

3 Circuit

We designed and developed the entire concept into a functional device by integrating all the mentioned components into a single unit. The connections between the components are critical for the system to operate correctly.

Initially, we connect the load cell to the Arduino through the HX711 module. The HX711 module is essential for detecting the loads placed on the load cell. The saline bottle is suspended from the load cell using a hook, allowing the load cell to measure the weight of the saline bottle accurately. In the code written for the Arduino, we set a specific weight threshold. If the weight of the saline bottle falls to or below this threshold, our system triggers an alert notification to the hospital management system. This alert notification includes information about the current level of the saline in the bottle, ensuring that healthcare providers are promptly informed and can take necessary actions.

The integration of these components allows for real-time monitoring of saline levels, significantly enhancing patient safety and reducing the workload on healthcare staff. The system effectively automates the monitoring process, providing timely alerts that help prevent critical situations in patient care.

Figure 3: Whole Setup

4 Background

The Internet of Things (IoT) has emerged as a transformative force across various industries, including healthcare. The integration of IoT in medical facilities has the potential to revolutionize patient care by enabling real-time monitoring, improved data collection, and enhanced communication between devices.

The need for efficient monitoring systems has become increasingly evident, particularly in critical care environments where timely interventions can significantly impact patient outcomes. Saline solutions are commonly used in hospitals for intravenous therapy, serving essential functions such as hydration, medication delivery, and electrolyte balance.

However, manual monitoring of saline levels poses several challenges, including human error and oversight. The consequences of failing to monitor saline levels can be dire, leading to complications such as fluid overload, electrolyte imbalances, and in severe cases, death. Thus, it is imperative to develop an automated system that minimizes these risks and enhances patient safety.

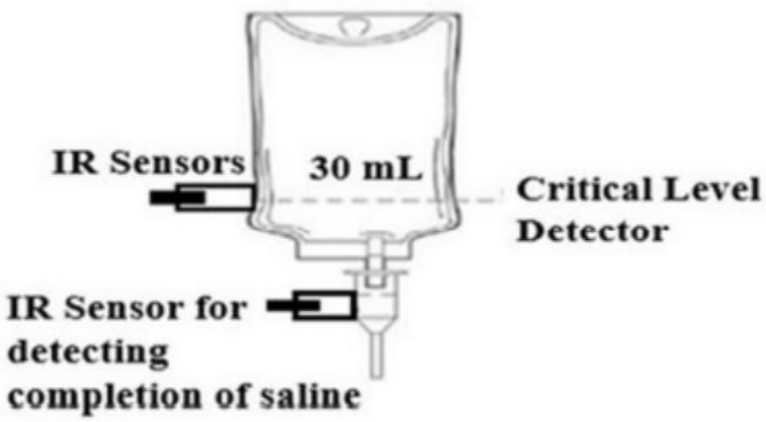


Figure 4: Schematic

4.1 Current Monitoring Practices

Traditionally, nurses and caregivers manually check saline levels at regular intervals. This process, while necessary, is labour-intensive and prone to lapses in attention. In busy hospital settings, where nurses may be responsible for multiple patients, the risk of oversight increases. As a result, there is a growing demand for innovative solutions that leverage technology to ensure continuous and reliable monitoring of saline levels.

4.2 Importance of Automation

Automating saline level monitoring not only reduces the dependency on healthcare staff but also ensures that critical alerts are communicated promptly. An IoT-based monitoring system can provide real-time updates and notifications, allowing healthcare providers to respond swiftly to changes in patient conditions. By integrating sensors, data analytics, and user-friendly interfaces, this system can enhance decision-making processes and improve overall patient care. **Feature Calculation**

4.3 Technological Components

The proposed saline level monitoring system employs a combination of infrared (IR) sensors and microcontroller technology to achieve accurate monitoring. The IR sensor detects changes in fluid levels, and the microcontroller processes this data to trigger alerts when thresholds are crossed. This setup allows for a streamlined communication system between the patient's saline bottle and the nursing staff, ensuring timely intervention when necessary.

The use of a web application or smartphone app for monitoring provides an added layer of convenience and accessibility. Healthcare providers can receive alerts directly on their devices, enabling them to manage their time more effectively while ensuring that patients receive the care they need without delay.

5 Result and Conclusion

In conclusion, the development of an IoT-based saline level monitoring system addresses a critical gap in patient care within hospital environments. By leveraging advanced sensor technologies and automated alert systems, we can enhance the safety and efficiency of saline administration. This project aims to set a precedent for future innovations in healthcare technology, ultimately leading to improved patient outcomes and reduced workload for healthcare professionals.

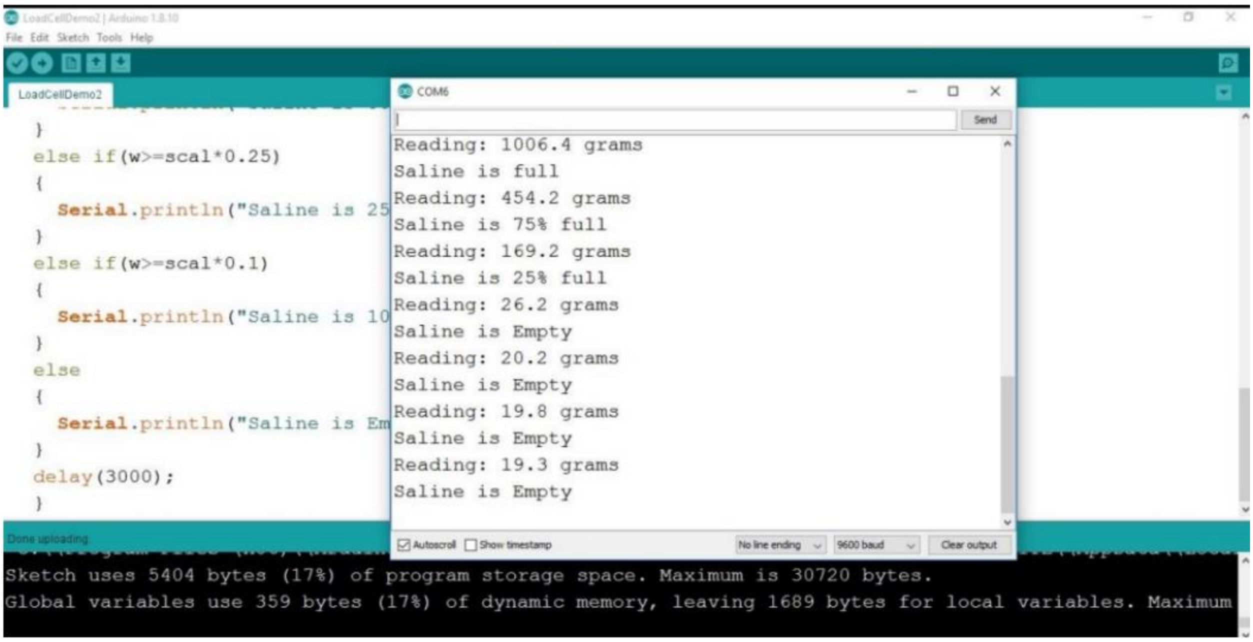


Figure 5: Result

6 Future Scope

Future research could focus on the following areas:

- Smaller Dimensions Box: To reduce the size of the box while maintaining the functionality by using smaller components and optimising component layout.
- Automatic Switching Between Drips: Expand the system to monitor multiple saline drips simultaneously by incorporating multiple load cells and HX711 sensors, potentially with a user interface for monitoring several patients or infusion bags.
- Data Logging and Analytics: Implement data logging to track saline usage patterns and generate reports. This data could be useful for optimizing patient care and managing inventory.

Acknowledgements: We express our gratitude to all those who contributed to the successful completion of this project, especially AICTE IDEA Lab-Guru Gobind Singh Indraprastha University, our mentors, and team members.

7 Project Images

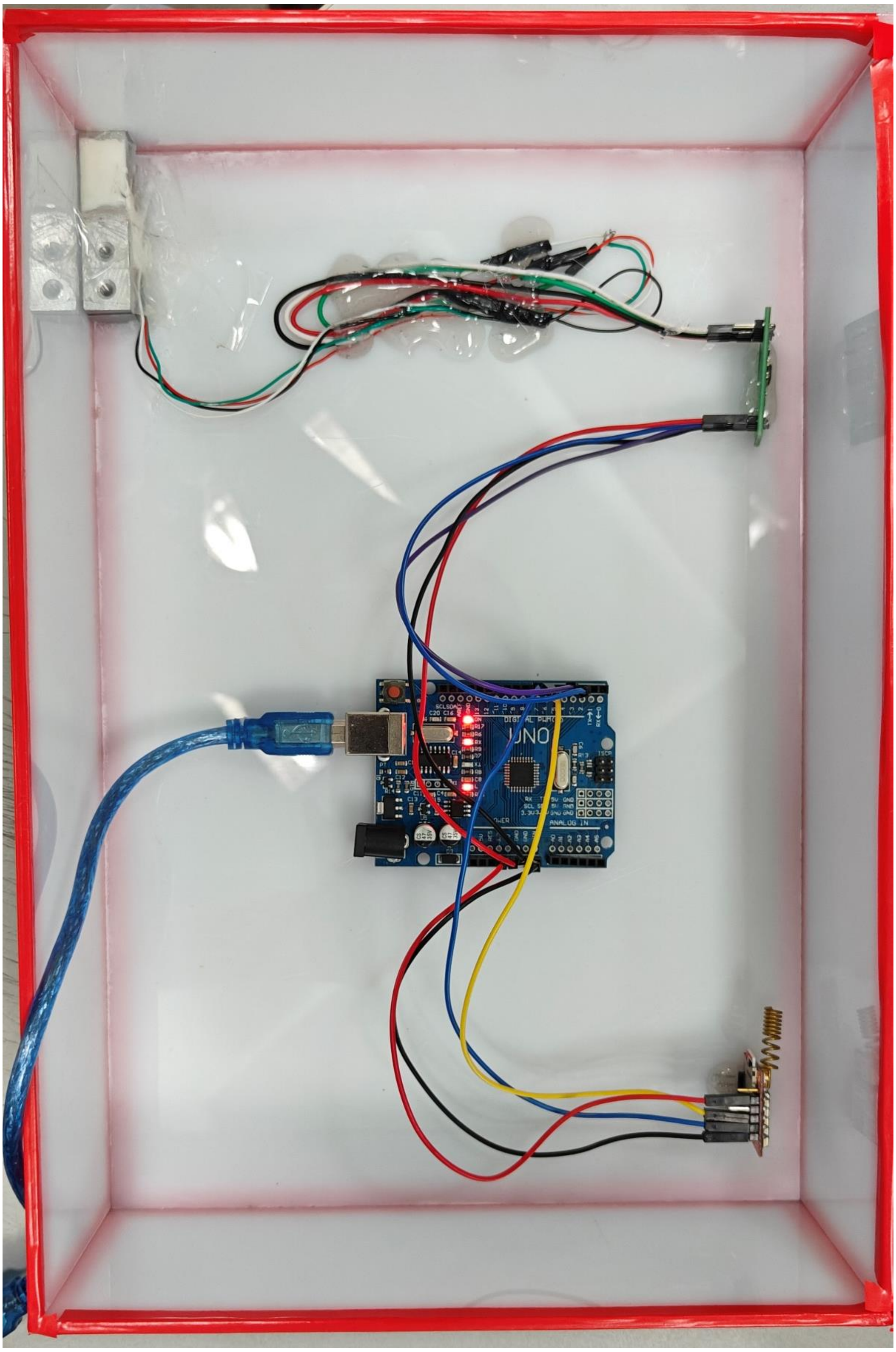


Figure 7.1: Final Project

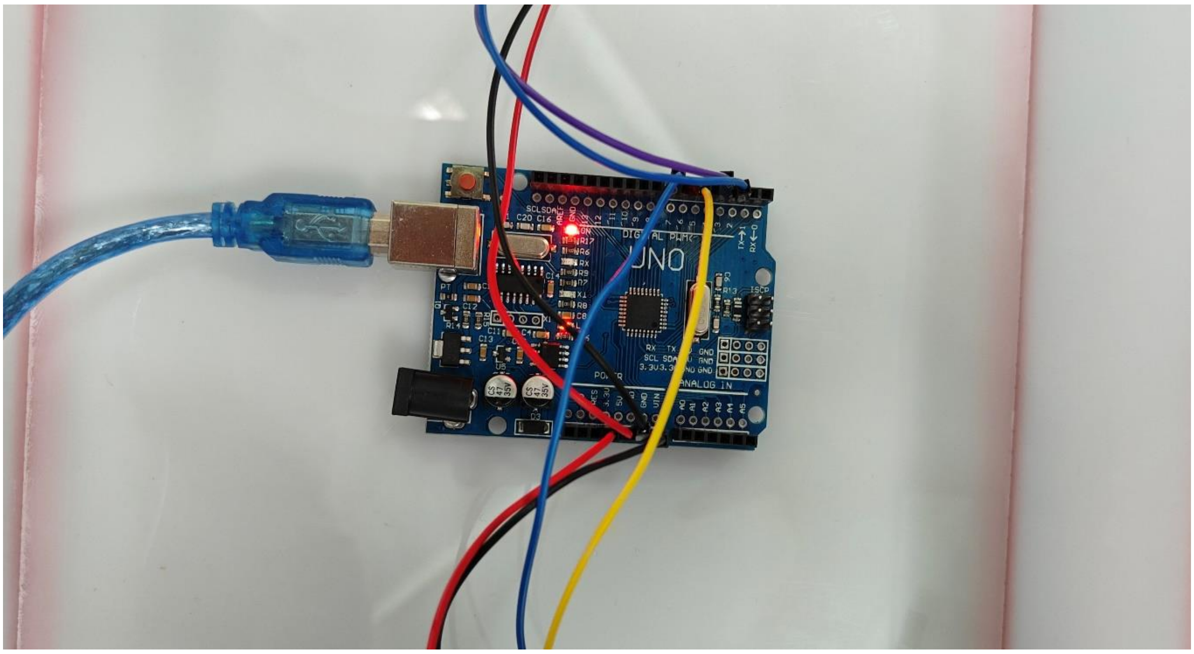


Figure 7.2: Arduino Connections

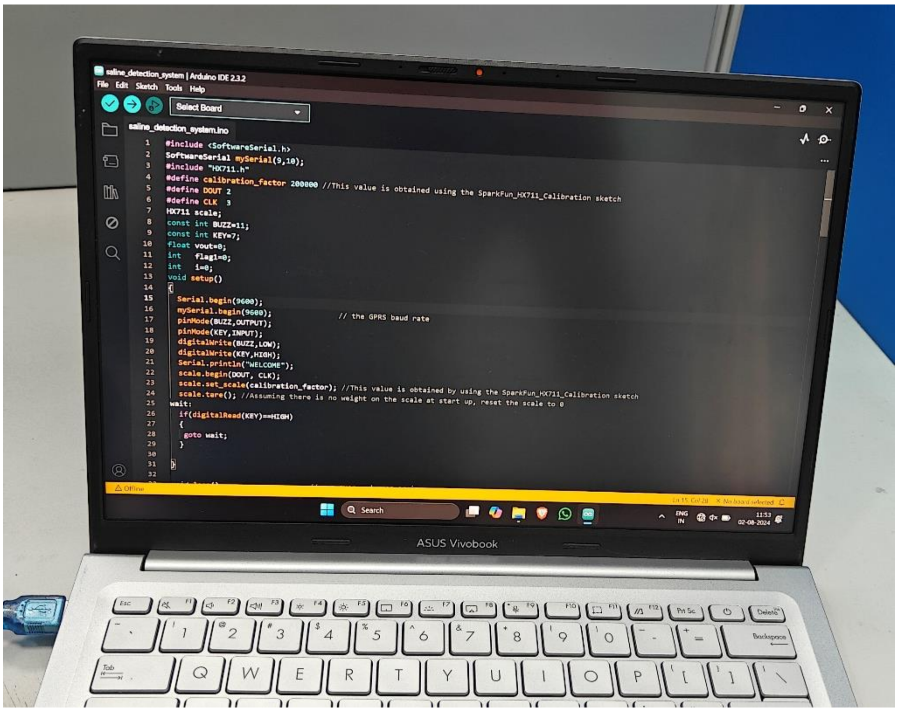


Figure 7.3: Arduino Code

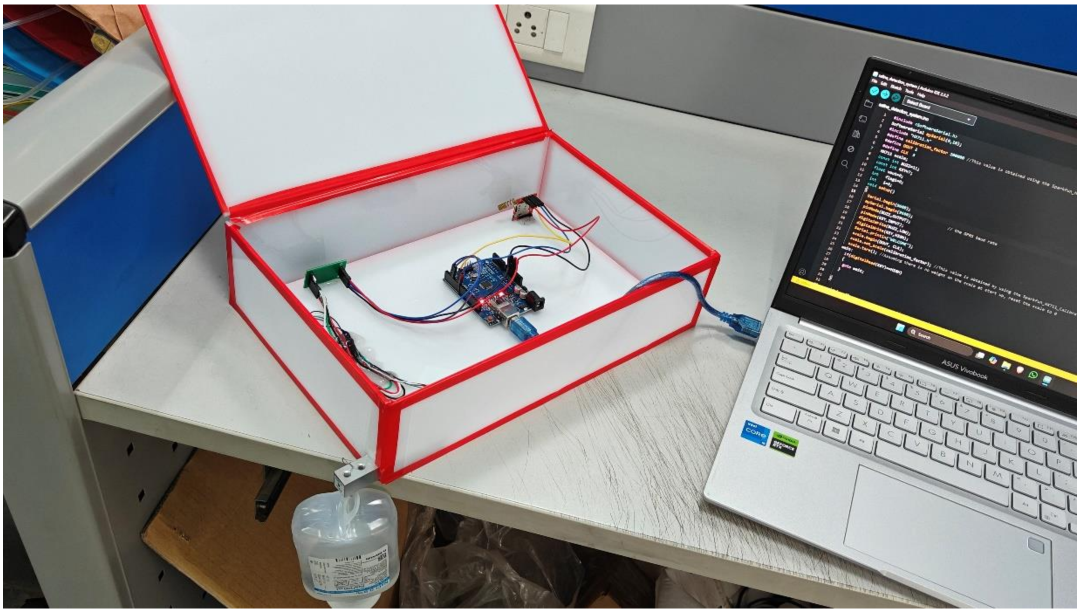


Figure 7.4 Whole Setup

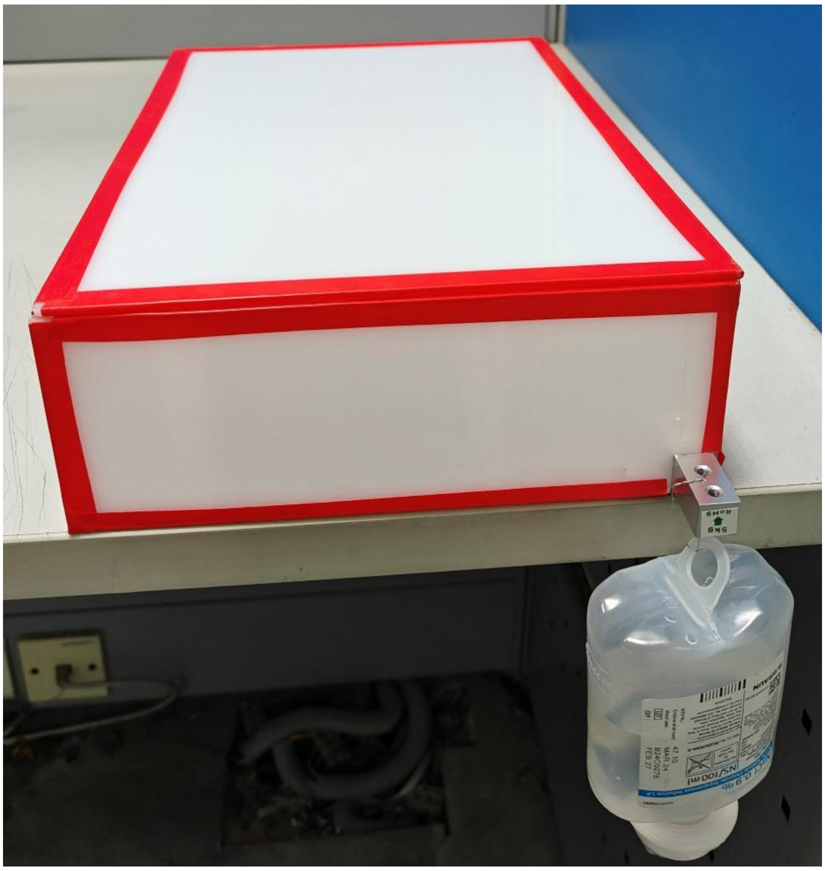


Figure 7.5

8 Bibliography

References

[1] Tawade, E. S., Pendse, M. S., & Chaudhari, H. P. (2014). Design and development of saline flow rate monitoring system using flow sensor, microcontroller and RF ZigBee module. International Journal of Engineering Research and General Science (IJERGS), 3(3).

[2] Rangsee, P., Suebsombut, P., & Boonyanant, P. (2014). Low-cost saline droplet measurement system for common patient room in rural public hospital. In Joint International Conference on Information and Communication Technology, Electronic and Electrical Engineering (JICTEE). IEEE.

[3] Goepel, E. (1989). The ink drop sensor: A means of making ink-jet printers more reliable. In CompEuro'89. VLSI and Microelectronic Applications in Intelligent Peripherals and their Interconnection Networks, Proceedings. IEEE.

[4] Thongpance, N., Pititeeraphab, Y., & Ophasphanichayakul, M. (2012). The design and construction of infusion pump calibrator. In Biomedical Engineering International Conference (BMEiCON). IEEE.

[5] Gavimath, C. C., Bhat, K., Chayalakshmi, C. L., Hooli, R. S., & Ravishankera, B. E. (2012). Design and development of versatile saline flow rate measurement system and GSM based remote monitoring device. International Journal of Pharmaceutical Applications, 3(1), 277-281. Retrieved from http://www.bipublication.com

[6] Priyadharshini, R., Mithuna, S., Kumar, U. V., Devi, K., & Vanitha, D. S. (2015). Automatic intravenous fluid level indication system for hospitals. International Journal for Research in Applied Science Engineering Technology (IJRASET), 3(8).

[7] Dharmale, A. A., Mehare, R. R., Bharti, A. R., Meshram, S. R., & Deshmukh, S. V. (2019). IoT based saline level monitoring and automatic alert system. International Journal of Advanced Research in Computer and Communication Engineering, 8(4).