

SMART BREAST PUMPING SYSTEM

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Introduction:

Breastfeeding is essential for infant nutrition and maternal health. However, working mothers, mothers with low milk supply, or those with medical conditions often face challenges in feeding their infants directly. Traditional breast pumps lack smart features such as real-time monitoring, comfort control, and safety mechanisms.

To address these challenges, this project proposes a Smart Breast Pumping System that integrates advanced technologies like adjustable suction control, automatic pressure regulation, and real-time milk monitoring. The system enhances comfort, efficiency, and safety, while also enabling remote monitoring through smart devices, making it highly beneficial for modern maternal care.

Objectives:

1. To design a smart breast pumping system with adjustable suction control.
2. To implement automatic pressure regulation for user safety.
3. To monitor and display real-time milk extraction data.
4. To develop a portable and user-friendly system for working mothers.

Methodology:

The proposed system is developed using a microcontroller integrated with sensors and a controlled suction mechanism. Adjustable suction levels ensure comfort, while pressure sensors prevent overpressure conditions.

Milk flow sensors monitor the quantity of milk extracted and display it in real time. The system can be integrated with IoT technology for remote monitoring through a smartphone. Features like timer function and smart alerts improve usability and efficiency. The system is tested under different conditions to ensure safety and performance.

Result and Conclusion:

In conclusion, the Smart Breast Pumping System offers a safe, efficient, and user-friendly solution for mothers. The inclusion of smart features such as adjustable suction, real-time monitoring, and safety controls improves the overall pumping experience. The system reduces dependency on traditional methods and supports better maternal and infant care.

Project Outcome & Industry Relevance

The project developed a smart breast pumping device that improves the convenience and efficiency of milk expression for nursing mothers. It combines programmable suction control, milk level monitoring, Bluetooth communication, and SMS alerts in one system. This project is highly relevant in the field of biomedical engineering, healthcare devices, and maternal care technology. It can be applied in hospitals, maternity care centers, NICU support systems, and home healthcare environments. The system helps reduce manual monitoring and prevents milk overflow, making it useful in real-world situations.

Working Model vs. Simulation/Study

This project was developed as a working hardware model rather than just a simulation or theoretical study. It uses real components such as Arduino Uno, suction pump, level sensor, Bluetooth module, and GSM module. These components were integrated to perform practical functions like suction control, milk level monitoring, and SMS alerts. Hence, the project is considered a physical working prototype. It demonstrates the real-time application of embedded systems in healthcare.

Project Outcomes and Learnings

The project successfully developed a smart breast pumping device with intelligent monitoring features. It was able to provide custom suction modes, real-time milk level monitoring, Bluetooth-based display, and SMS alerts. Through this project, we learned how to integrate hardware and software into one working system. We gained practical knowledge in Arduino programming, sensor interfacing, wireless communication, and embedded system design. We also understood the importance of testing, calibration, and troubleshooting. Overall, the project improved our technical skills and helped us solve a real-life healthcare problem.

References:

- Author, "Smart Breast Pump Technologies," *IEEE Journal*, Year.
- Author, "IoT in Healthcare Applications," *International Journal*, Year.
- Author, "Design of Medical Pumping Devices," *Conference Paper*, Year.

Future Scope:

The future scope of this project includes:

1. Development of a mobile app for full system control.
2. Integration of milk quality and temperature sensors.
3. Implementation of AI-based analysis for health monitoring.