IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

INFANT LIFE SAVING SYSTEM: CLASSIFICATION OF BREASTMILK STAGE AND MONITORING USING NEOTRIC TECHNOLOGY

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ABSTRACT

Breastmilk monitoring is essential in neonatal care as it plays a significant role in the growth and development of infants. Conventional techniques for breastmilk monitoring are often labor-intensive, time-consuming, and prone to human error. Therefore, the need for an automated system that can accurately identify, monitor, and classify breastmilk has arisen. The conventional techniques for breastmilk monitoring involve manual recording of the date, time, and quantity of breastmilk. The milk is then labeled with the mother's name and stored in a refrigerator. However, this method is prone to human error, and it is challenging to track the expiration of breastmilk. In this paper, we propose an RFID-based breastmilk identification and monitoring system that utilizes a humidity sensor, a temperature sensor, and a breast milk stage classification system using a pH and color sensor. The proposed system utilizes RFID technology to accurately identify and monitor breastmilk. Each bottle / pack of breastmilk is tagged with an RFID tag that contains information about the mother, the date and time of expression, and the volume of milk. The system also includes a humidity sensor and a temperature sensor to monitor the storage conditions of breastmilk in the refrigerator. The breast milk stage classification system uses a pH and color sensor to classify breastmilk into three stages: colostrum, transitional milk, and mature milk. The pH and color sensor measures the pH level and color of breastmilk and compares them with pre-defined values for each stage. A breast milk stage classification system using a pH and color sensor provides an automated, accurate, and reliable method for breastmilk monitoring. This system has the potential to reduce human error, save time, and ensure the provision of quality care to infants.

Keywords: PH level, Breastmilk, Sensor and RFID technology

1. INTRODUCTION

The majority of mothers is encouraged to breastfeed their babies, however the problem with breastfeeding arise when the baby is sick or is admitted to the hospital, particularly in cases of premature infants. Also, the mothers may be unable to provide a full volume of milk due to numerous physical and emotional barriers to breastfeeding. These at risk infants will benefit a lot from the breast milk nutrients and in case the mother is unable to provide the breast milk, then the pasteurized donor milk from a healthy mother should be the first consideration for supplementation. In such cases the role of breast milk banks becomes very important as these are the place where the donor breast milk is stored and is made available, for use in vulnerable populations. India is a developing country where the neonatal mortality is very alarming. The breast milk banks are very

essential for the control of the cases of neonatal mortality and malnutrition. This commentary will briefly review the importance of breast milk banking in India, as well as the best available evidence for donor milk use in the vulnerable population, including available economic analyses, with a view to advocate for its use in these vulnerable infants. Indian scenario The first human milk bank opened in Vienna, Austria in 1909 and the first in North America opened in 1919 in Boston, USA. There are around 517 breast milk banks all over the globe. However, the first breast milk bank in Asia came into existence in Mumbai, India in 1989 at the Sion Hospital. Presently, there are around 14 such banks in India. However, the first public sector breast milk bank came into existence in 2013 in Kolkata. breast milk banks are to ensure that every baby born or milk, to avoid bottle, animal and formula milk, to heighten breastfeeding awareness, to give ancillary support to breastfeeding practices and to promote Baby Friendly Hospital care. The importance of breastfeeding Breast milk feeding decreases the incidence of many infectious diseases in infancy, including bacterial meningitis, bacteremia, diarrhea, respiratory tract infections, otitis media and urinary tract infections. Nevertheless, it has been shown that human breast milk-fed infants in the neonatal intensive care unit have less severe infections, less necrotizing enter colitis (NEC) and a reduction in colonization by pathogenic organisms. The results of a study conducted in Spain show that each additional month of exclusive breastfeeding may reduce hospital admissions secondary to infection by as much as 30% in the first year of life. Breastfeeding has also been linked to a decrease in Sudden Infant Death Syndrome. Breast milk has also been associated with enhanced performance on neurocognitive testing. Breastfeeding is also an important preventative health measure for the lactating mother, as it is associated with a decrease in the incidence of both breast and ovarian cancers, and a delay in the return of ovulation and greater postpartum weight loss. Breastfeeding is economical for families, with no need to purchase bottles and formula. Cost analyses indicate further savings to society in general; by improving the health of both mothers and infants, breastfeeding reduces loss of productivity due to illness. The benefits of breastfeeding are manifold and extensively cited by the WHO, UNICEF and many others. A temperature sensor is used in milk banks to ensure that the milk is stored at the correct temperature to maintain its safety and nutritional value. Breast milk is a perishable food product, and its quality can degrade rapidly if it is not stored at the correct temperature. The optimal storage temperature for breast milk is between 0-4°C (32-39°F). If the temperature rises above this range, bacteria can grow quickly, leading to spoilage and potentially harmful levels of bacteria by using a temperature sensor in a milk bank, staff can monitor the temperature of the stored milk and ensure that it stays within the recommended range. This helps to maintain the safety and nutritional value of the milk, making it safe for consumption by infants who are unable to breastfeed directly from their mothers. Humidity refers to the amount of moisture in the air, and it can affect the quality and safety of breast milk. High humidity can cause moisture to build up on the surface of milk containers, which can lead to the growth of harmful bacteria. On the other hand, low humidity can cause the milk to lose moisture, which can affect its nutritional content and quality.

By using a humidity sensor in a human breast milk bank, staff can monitor the humidity levels and ensure that they are within the optimal range. The recommended humidity level for breast milk storage is between 30-50%. By maintaining this range, the milk is less likely to be contaminated by harmful bacteria, and its nutritional content is preserved. Breast milk banks use Radio Frequency Identification (RFID) technology to track and manage breast milk donations. RFID tags are small devices that can be attached to containers of breast milk or to the donor's identification card. These tags contain a unique identification code that can be read by an RFID reader. An RFID reader is a device that uses radio waves to communicate with RFID tags. The reader can detect the presence of the tag and read its identification code. In a breast milk bank, RFID readers are used to track the movement of breast milk containers and to ensure that they are properly stored and handled. The use of RFID technology in breast milk banks can help improve efficiency and reduce errors in the management of donated breast milk. It allows for real-time tracking of donations and helps ensure that the milk is used in a safe and efficient manner. Additionally, RFID technology can help ensure that milk is not mixed up, which is important for maintaining the quality of the milk and for ensuring the safety of the infants who receive it.Breast milk is produced naturally by women and provides basic nutrition for a baby during the first several months of life. Your breast milk is made to order for your baby and provides the specific nutrients your baby needs to grow, both in size and maturity. Breast milk has three different and distinct stages: colostrum, transitional milk, and mature milk

2. AIM

To develop an IoT and RFID-based breastmilk identification and monitoring system that can track the status of breastmilk and provide real-time feedback to nursing mothers. The system will use various sensors such as humidity, temperature, pH, and color sensors to monitor the breastmilk's quality and classify the breastmilk stage. The system will be equipped with RFID tags to identify and track individual breastmilk bottles and provide an accurate record of the breastmilk's journey from the time it is pumped until it is consumed by the baby.

3. OBJECTIVE

To design an IoT-based breastmilk monitoring system that can provide real-time feedback to nursing mothers regarding the status of breastmilk. To develop an RFID-based identification system that can accurately identify and track individual breastmilk bottles. To integrate various sensors such as humidity, temperature, pH, and color sensors into the system to monitor the quality of breastmilk. To develop a breastmilk stage classification system using pH and color sensors that can classify breastmilk into different stages based on its composition and nutritional content. To provide a user-friendly interface for nursing mothers to access and monitor the breastmilk status and receive alerts when the breastmilk quality is compromised. The ultimate goal of this project is to provide nursing mothers with a reliable and easy-to-use system that can ensure the safety and nutritional quality of their breastmilk, thereby promoting the health and well-being of their babies.

4. LITERATURE SURVEY

LERATO MOLEFE; ANDRE J HENNEYET "DONATED BREASTMILK MONITORING IN THE WESTERN CAPE'S MILK BANKS" – IEEE 2022 CONFERENCE

The existing system is to provide tracking of milk from donating mothers to babies in need of milk. Furthermore, the project aims to provide the milk bank staff with real-time feeds or dashboards to display milk bank stock levels and environmental reporting. Moreover, the solution is required to monitor the amount of milk wasted in an attempt to minimize the wastage of a scarce, but essential resource. Monitoring stock levels and wastage manually is a cumbersome task that is very prone to human error.

KAREN MAC "SCREENING DONATED BREAST MILK IN THE DEVELOPING WORLD: MARKET EVALUATION AND NEEDS IDENTIFICATION FOR RAPID AND SUSTAINABLE METHODS OF SCREENING DONATED MILK AT HUMAN MILK BANKS"-CONFERENCE 2018

This existing system presents a comprehensive review detailing the different methods of pasteurization (including the Holder Method and flash pasteurization) and screening (such as Dornic acidity, bacterial culturing, and crematocrit method) at human milk banks in both developed and developing countries. Understanding different practices worldwide will help in identifying gaps in current efforts to ensure the safety of donated milk, highlighting areas for possible technology development and implementation.

JOSHUA LOIS C. PAULINO "MILK BANK PH: A WEBSITE FOR DONATING AND RESERVING BREASTMILK FOR INFANTS" – IEEE 2021 CONFERENCE

This existing system will be exploring the whole functionality of the system developed as well as shed light on the need for a centralized, digitized, online system for Hospitals and Human Milk Bank Organizations. The Milk Bank PH system development methodologies comprise the project development sequence, system architecture, unified model language, system map, and database. Based on the respondent's score on the UAT testing, the system gathers an average score of 84.67. Making the system itself fulfill the functionalities and design of the website

DENNIS R. "MILKTRACK: DESIGN AND DEVELOPMENT OF MOBILE APPLICATION AND LOGISTICS SYSTEM IN EMPOWERING BREASTFEEDING PRACTICE IN THE PHILIPPINES" – IEEE 2021 CONFERENCE

In this existing, the researchers present the development of a mobile application, Milk track, that will help the Filipino people in achieving one of its goals in health care which is to reduce infant mortality rate as well

as to prevent under-nutrition and stunted growth among children through empowering the breastfeeding practice in the country. The features of the mobile application will include information and tutorials about breastfeeding, breastfeeding station locator, and a platform for breastmilk donor to donate their excess and for recipients to have available supply most of the time. The paper also covers the establishment of the logistic system for proper acquisition of donated breastmilk, transport and delivery of the breastmilk to the recipients.

NITZEL LYKA PARUAN "GMILK: A FRAMEWORK FOR MOBILE AND WEB APPLICATION FOR BREAST MILK SERVICES IN THE PHILIPPINES" – IEEE 2021 CONFERENCE

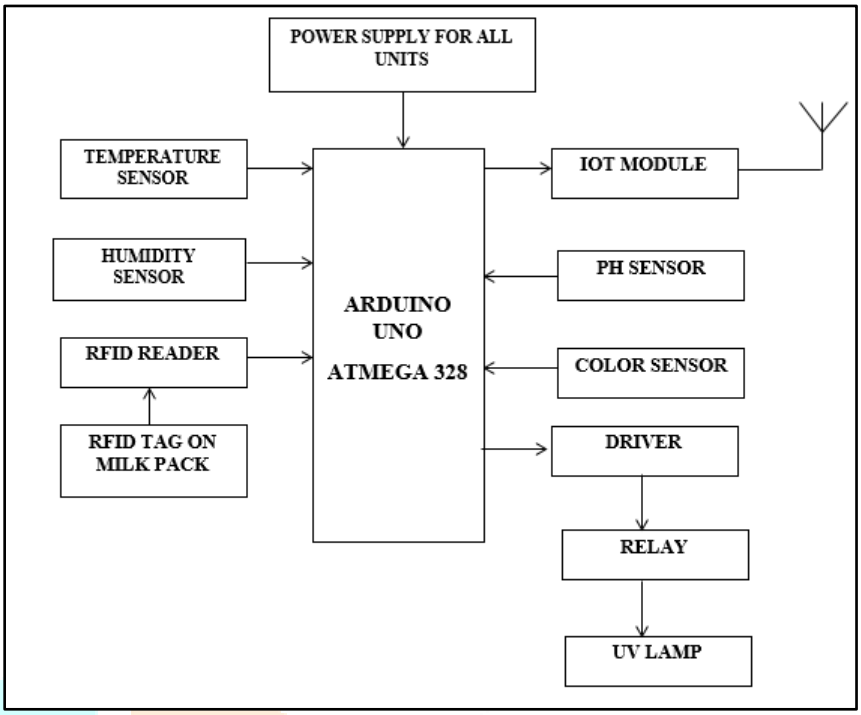
They have developed a facilitate milk donation and requests, this study presents a framework for mobile and web applications where donors and requestors can easily search the nearest milk recipients, request and donate breast milk with a validation process to address the gaps. With this, possible risks coming from donor milk can be eliminated. Also, this study will help donors and requestors learn more about the essential information on milk sharing and other mothering-related info. Furthermore, this proposed application will serve as a platform for mothers to connect those in need and those blessed to produce breast milk.

5. EXISTING SYSTEM

The existing system which describes the actions that the end-user will have to perform in order to operate and monitor the system. The end user will at first, must switch the system on and check the alarm indications - whether all the components of the system are connected and functional. If the alarm system indicates certain components of the system are disconnected or malfunctioning, the end user will have to replace or connect them to the system and monitor the alarm system again to verify that they all connected, When the alarm system indicates positive results, the end user will have to operate the controller with the aim to check/ monitor the temperature and the level of the milk. The end user will also monitor the power being consumed by the system. After the process of operating the system, the end-user will then have to deliver the cooled milk inside the tanker to respective dairy processing plants. The control unit will have the buttons and screen through which the end-user will operate to view the status (level and temperature) of the milk inside the tanker. The TECM from laird technology/TE technology Inc., usually comes with heat sink and fan already assembled, depending on the application for which they are needed. The cooling capacity of the thermoelectric cooling system is dependent on the operating temperature of the content desired for cooling, quantity of thermoelectric modules used, the type of thermoelectric module used and the applied power. The Marlow guide, will be used in this case to select the applicable TECM which will be compatible for the research. Firstly, the heat load capacity of the milk needs to be determined to select the applicable TECM which will be able to provide cooling capabilities. As such, the selected TECM must be able to handle the temperature difference of 34 °C. The cooling capacity of the milk, in this case, is determined to select the right TECM for the application.

6. PROPOSED SYSTEM

Breastfeeding is vital for infant nutrition, and it is crucial to ensure that the breast milk consumed by infants is safe and of high quality. An IoT and RFID based breastmilk identification and monitoring system can help ensure that infants receive safe and healthy breast milk. The proposed system uses humidity and temperature sensors to monitor the storage conditions of the breast milk, RFID tags to identify the breast milk, and pH and color sensors to classify the breast milk stage. The system also includes a mobile application that allows users to monitor the breast milk's quality and track its consumption. RFID Reader: The RFID reader is used to identify the breast milk bottles and to track their movement in the system. RFID Tags: The RFID tags are attached to the breast milk pack / bottles to identify them uniquely and to store information about the milk, such as its expiry date and the stage of the milk. Temperature Sensor: The temperature sensor is used to monitor the temperature of the breast milk and to ensure that it is stored at the correct temperature. Humidity Sensor: The humidity sensor is used to monitor the humidity of the storage area and to ensure that the breast milk is not exposed to moisture. pH Sensor: The pH sensor is used to classify the breast milk stage by measuring its acidity level. Color Sensor: The color sensor is used to classify the breast milk stage by measuring its color. UV lamp: Uv lamp is used for sterilization of the milk bottle



7.RESULT AND DISCUSSION

Breastmilk monitoring is essential in neonatal care as it plays a significant role in the growth and development of infants. Conventional techniques for breastmilk monitoring are often labor-intensive, time-consuming, and prone to human error. Therefore, the need for an automated system that can accurately identify, monitor, and classify breastmilk has arisen. The conventional techniques for breastmilk monitoring involve manual recording of the date, time, and quantity of breastmilk. The milk is then labeled with the mother's name and stored in a refrigerator. However, this method is prone to human error, and it is challenging to track the expiration of breastmilk. In this paper, we propose an RFID-based breastmilk identification and monitoring system that utilizes a humidity sensor, a temperature sensor, and a breast milk stage classification system using a pH and color sensor. The proposed system utilizes RFID technology to accurately identify and monitor breastmilk. Each bottle / pack of breastmilk is tagged with an RFID tag that contains information about the mother, the date and time of expression, and the volume of milk. The system also includes a humidity sensor and a temperature sensor to monitor the storage conditions of breastmilk in the refrigerator. The breast milk stage classification system uses a pH and color sensor to classify breastmilk into three stages: colostrum, transitional milk, and mature milk. The pH and color sensor measures the pH level and color of breastmilk and compares them with pre-defined values for each stage. A breast milk stage classification system using a pH and color sensor provides an automated, accurate, and reliable method for breastmilk monitoring. This system has the potential to reduce human error, save time, and ensure the provision of quality care to infants. result and discussion

8. CONCLUSION

The proposed breastmilk monitoring system using RFID technology and a breast milk stage classification system with pH and color sensors is a promising solution to the challenges faced by conventional techniques for breastmilk monitoring. The system has the potential to improve the quality of care provided to infants, reduce human error, save time, and ensure the provision of quality care to infants. Further research and development are necessary to optimize and validate this system for clinical use.

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