AN-NAJAH NATIONAL UNIVERSITY

FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

Computer Engineering Department

Hardware Graduation Project

Graduation Project II

Kiddy Milk Master

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Presented in partial fulfillment of the requirements for Bachelor'sdegree in computer engineering.

Acknowledgment

Foremost, we express our gratitude to the divine for the bestowed blessings and guidance throughout this meaningful endeavor. Our hearts are replete with appreciation as we anticipate the knowledge, we have acquired will bring benefit to the global community, particularly in Palestine.

We extend our sincere appreciation to our families for their steadfast support and encouragement, which has been a consistent wellspring of strength from the project's inception to its culmination. A special acknowledgment is reserved for Dr. Aladdin Masri, whose unwavering assistance and abundant resources played a pivotal role in facilitating the successful completion of this project.

Our heartfelt thanks are extended to our esteemed colleagues in the Department of Computer Engineering. Their guidance and teachings have proven instrumental in shaping our journey, and we hold deep appreciation for their contributions over the years.

To all those who stood by us through every challenge and triumph, your steadfast support warrants our profound gratitude. From the depths of our hearts, we convey a resounding "Thank You." With immense appreciation, we take pride in presenting this report and project to you.

Disclaimer

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Abstract

This project aims to make the process of preparing milk bottles for infants much more convenient for parents, particularly mothers. Preparing infant formula can be a time consuming task, especially during late-night feedings. With this machine, parents can automate and simplify this process, saving time and effort. The machine ensures precision in preparing the milk bottles, including sterilization, temperature control, and precise measurements for water and milk powder. This precision can help prevent common issues like milk being too hot or too cold, which can be harmful to an infant. Accurate milk preparation, temperature control, and sterilization can contribute to the overall health and well-being of the baby, reducing the risk of digestive issues or exposure to harmful bacteria. The main objectives of the project are centered around simplifying and enhancing the process of infant milk bottle preparation, ensuring safety and health, and providing parents with a convenient and reliable solution for their caregiving needs. So the machine makes milk bottles for children . At first ,the mother can choose one of two modes (Decide the period to get the machine work periodically and the second mode is determining the amount of water she wants to be used) Then the machine starts sterilizing the bottle ,heating water ,make sure that the water is suitable to be drunk, putting the milk powder , adding hot water , mixing the milk ,maintain the temperature of the milk so anytime the mother takes the bottle she finds it hot ,and send a notification for the mother to tell her that the milk is ready. The mother can also send a command to the machine to start the procedure. In foreign countries ,this machine is available in hospitals only. So only nurses can deal with it . But mothers now can deal with Kiddly Milk Master to make it easier for them in their daily lives. And one big difference is that mothers can receive notifications that the milk is ready and also then can send a command anytime for the machine to start working and making milk bottles read

Chapter 1: Introduction

1.1 : Statement of the problem

The formidable demands and responsibilities placed upon mothers during the initial stages of child rearing present a persistent challenge. Recognizing the pivotal role of mothers as integral contributors to societal well-being and acknowledging their significance as half of the societal structure, we have identified a pressing need. Our focus is to address the time constraints faced by mothers by introducing a device designed to automate the preparation of infant milk. This device aims to not only streamline the process of milk preparation but also to preserve it until the opportune moment when the child is ready to breastfeed, thereby optimizing the mother's available time for other essential tasks.

1.2 : Objectives and Scope

The objectives that this project seeks to achieve are:

1. Develop an automated milk preparation device to alleviate the time constraints faced by mothers during the early stages of child care.

2. Enable mothers to efficiently and conveniently prepare infant milk, ensuring the nutritional needs of their children are met with ease.

3. Design a system that allows for the preservation of prepared milk, facilitating its storage until the child is ready for breastfeeding.

4. Enhance maternal productivity by creating a technology that optimizes the time mothers spend on milk preparation, enabling them to allocate more time to other responsibilities and activities.

5. Contribute to the well-being of both mothers and infants by offering a practical solution to the challenges associated with early childcare.

Chapter 2. Constraints and Earlier Coursework

2.1 : Constraints

2.1.1 Technological Limitations:

The development of an automated milk preparation device may be constrained by the current state of available technologies, potentially affecting the device's efficiency and capabilities.

2.1.2 Cost Constraints:

Budget limitations may restrict the resources available for research, development, and production of the automated milk preparation device, influencing the overall feasibility of the project.

2.1.3 Cultural Sensitivity:

The design and features of the device need to align with cultural norms and preferences related to infant care, considering the diverse societal perspectives on parenting practices.

2.1.4 Implementation Issues:

Insufficient technical know-how led to difficulties in implementing the necessary technology for automating milk preparation. This includes challenges in integrating sensors, automated mechanisms, and ensuring the device operates reliably.

2.1.5 Regulatory Compliance:

The project must adhere to relevant health and safety regulations and standards associated with infant nutrition and care, potentially imposing constraints on certain design aspect

2.2 : Earlier Coursework

2.2.1 Digital circuits:

provide a foundational understanding of the principles governing the design and implementation of digital systems.

2.2.2 Microcontrollers and PIC

All the basics of the Arduino, and basic serial communicationwere taken in these courses.

2.2.3 Critical Thinking and Research Skills:

The research and the writing of this report was done using the knowledge gained from this course.

2.2.4 Electronic circuits courses

These courses highly contributed in dealing with different modules andfinding the right power sources and connection for each of them.

Chapter 3. Literature review

For manufacturers of infant milk bottles with automated features, the literature review highlights the gaps in current solutions to facilitate infant feeding. Existing research highlights the importance of the time mothers encounter in early child care and highlights the importance of technological innovation in addressing these challenges.

Studies show that mothers find it difficult to balance their responsibilities, especially preparing baby food by hand. Potential benefits such as time efficiency, stress reduction, and improved accuracy in milk production highlight the importance of automated solutions Research a performed in related areas such as home automation and smart food processing machines provide insights into the successful implementation of automated processes

Furthermore, existing literature emphasizes the importance of considering cultural and social values in the development and use of technology for infant care. This insight is critical to ensuring the adoption and effectiveness of self-made bottle manufacturers in various communities.

Despite growing interest in smart home devices, detailed research shows a lack of specific research on automated infant feeding. This highlights the innovations and potential impact of the infant formula bottle with technological advancements in the market.

In conclusion, the literature review highlights the need for automated solutions to overcome the challenges faced by mothers in infant formula formulation. The proposed baby milk bottle stands at the intersection of existing research on smart home appliances, kitchen appliances and special need.

Chapter 4. Methodology

This section is intended to show detailed information about the parts, methods and techniques used to develop the robot and displaying the results

4.1 Hardware components

4.1.1 Arduino mega 2560

The Arduino Mega 2560 is a micro-controller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro-controller. We tried to use the Arduino Uno as it supports all of our needs, but the limitation of the number of pins made us shift to the Arduino Mega.

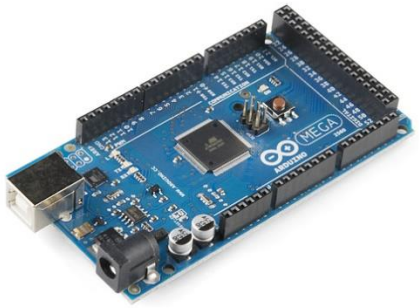

Figure 1 arduino mega 2560

4.1.2 Dc motors

A DC motor is an electro-mechanical device that transforms electrical energy into mechanical motion.The motor rotates because of an electromagnetic force produced by a commutator and brushes, which maintain a constant current flow in the coil. They are easy to use, versatile, and controllable.We used them to control the movement of the mixer , the maintaining and capping tools.

Figure 2 dc motor

4.1.3 Stepper motors

Steppers move in discrete increments or steps as opposed to typical motors, which eliminates the need for feedback devices and enables precise positioning.We used it to make the main arm which is handling the milk bottle to move steps to process each level.

Figure 3 stepper motor

4.1.4 Servo motor

A servo motor is a compact and precise electric motor used for controlled angular movement. It operates by receiving signals, typically in the form of pulses, to determine its position, speed, and direction. Servo motors find widespread application in robotics, automation, and various electronic devices where accurate and controlled movement is essential. We used it to open the milk store so milk goes down.

Figure 4 serco motor

4.1.5 Water pump

We used a water pump to pump water for sterilizing and adding water to the bottle.

Figure 5 water pump

4.1.6 Heating Element Mold Cartridge Heater

For applications needing effective heat transfer, the IIVVERR 10mm x 60mm AC Heating Element Mold Cartridge Heater is a small yet effective heating element. With a length of 60mm and a diameter of 10mm, it may be used in a variety of molding applications and industrial operations. This cartridge heater is a dependable option for temperature-sensitive procedures because it can swiftly and evenly heat molds or other settings .We used it to heat water for sterilizing.

Figure 6 heating element mold cartrige heater

4.1.7 Thermoelectric cooler/heater

semiconductor device that use the Peltier effect to create a heat flux between the

junctions of two materials. We used it to maintain the temperature of the milk in the bottle at 38 degrees -which is the best degree for kids children -. When the temperature is below 38 it works automatically as a heater. And when it is 38 it turns off.

Figure 7 peltier panel

4.1.8 LM35 temperature sensor

LM35 is precision integrated -circuit temperature sensor ,which output voltage is linearly proportional to the Celsius . we used it to sense the temperature of the milk.

Figure 8 LM35 temperature sensor

4.1.9 Clipper

A metal clipper is used for clipping on things . We used it to carry the cap from its place

and then the stepper motor moves it 90 degree then it opens so the cap is set on the bottle in its suitable place.

Figure 9 metal clipper

4.1.10 LCD with I2C

We used an LCD to display which spots are free and which are not to make it easier for those who do not use the application to find a place to park quickly. The LCD has 16 pins that should be attached to the micro 10 controller which is a lot of pins. To overcome this, we have used an I2C module that reduced the number of pins used to 4 only.

Figure 10 LCD

4.1.11 I2C

The I2C protocol involves using two lines to send and receive data: a serial clock pin (SCL) that the Arduino Master board pulses at a regular interval, and a serial data pin (SDA) over which data is sent between the two devices. Because the I2C protocol allows for each enabled device to have it's own unique address, and as both master and slave devices to take turns communicating over a single line, it is possible for the Arduino board to communicate (in turn) with many devices, or other boards, while using just two pins of the micro-controller.

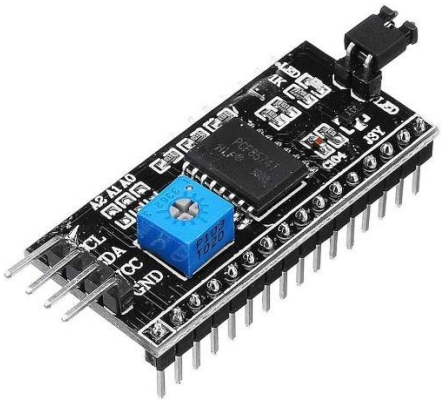

Figure 11 I2C

4.1.12 4*4 matrix Keypad

The 4x4 matrix keypad is a simple mechanism that resembles the numeric input on your computer keyboard, except that it has an additional '*,' '#' and 4 other auxiliary buttons that can be used for various functions. We used it to enter the amount of water the mother wants and the time to work periodically.

Figure 12 KEYPAD

4.1.13 Stepper motor driver

For the stepper motor ,we used motor drivers of type YS-DV268N-5A which is a stepper motor driver based on the system TB6600 allows you to control the motor with a coil with a voltage from 12 V to 48 V.It has 6 control modes :full-step,noncircular ½,1/4,1/8 and 1/1

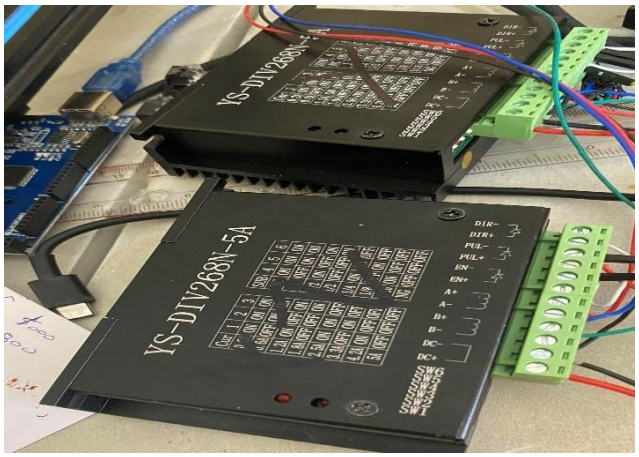

Figure 13 YS-DIV268N-5A driver

4.2 Circuits

4.2.1 LCD and I2C circuit

For LCD used in the system, I2C module was connected to the lcd in order to reduce the number of pins, and following the master slaves approach to communicate with the LCD through SDA and SCL ports, and the circuit below is for each LCD.

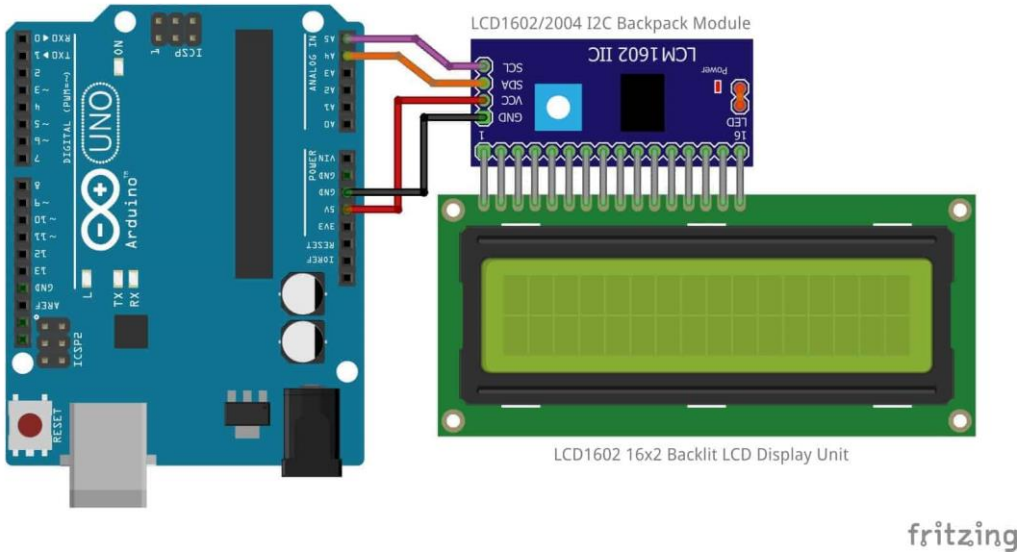

Figure 14 LCD ,I2C circuit

4.2.2 Keypad with Arduino circuit

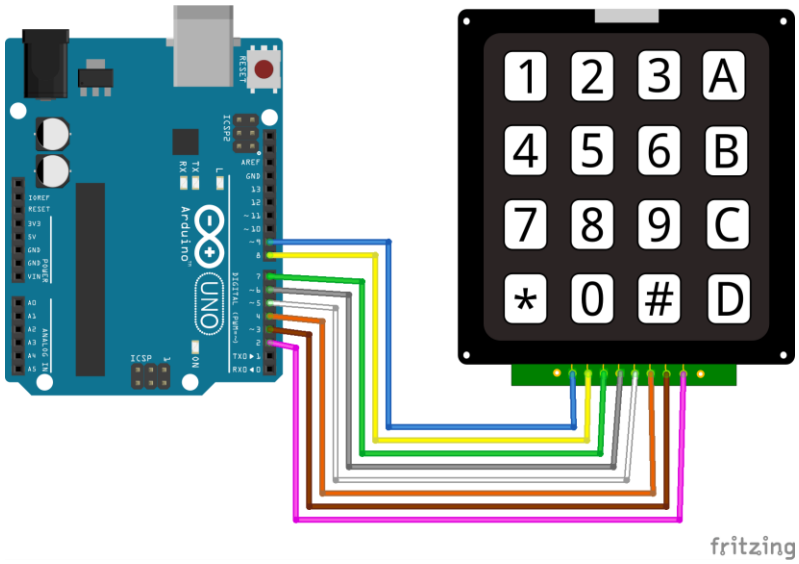

Figure 15 keypad circuit

4.2.3 Water pump circuit

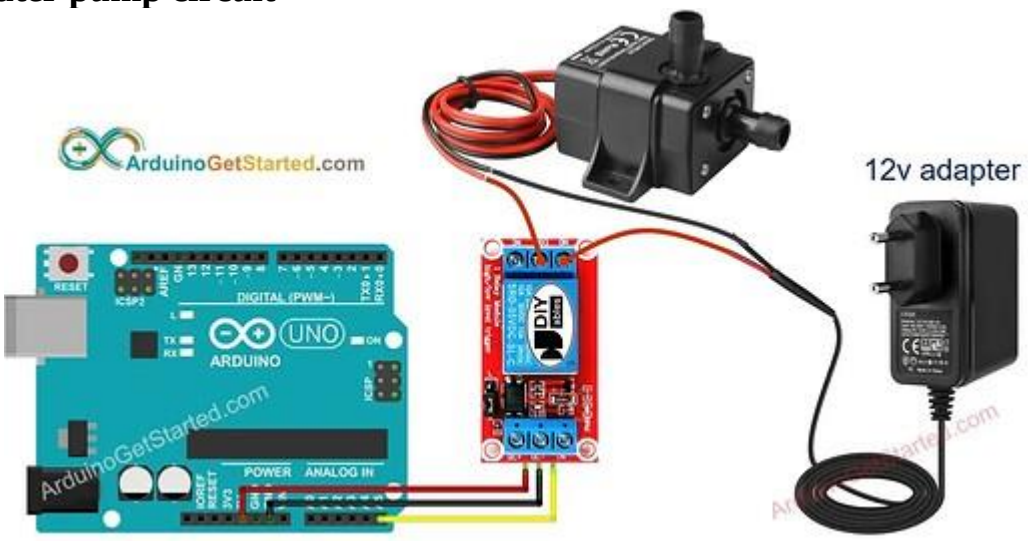

Figure 16 water pump circuit

4.2.4 DC motor circuit

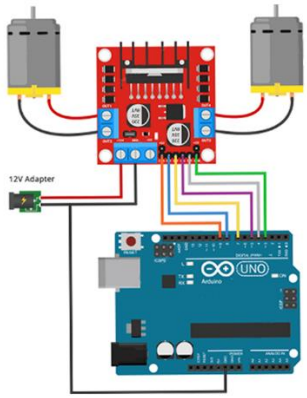

Figure 17 dc motor circuit

4.2.5 Servo motor circuit

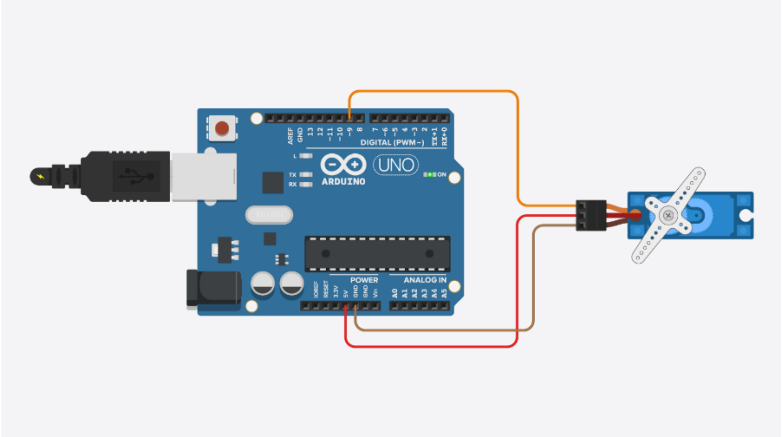

Figure 18 servo motor circuit

4.2.6 Heating wire circuit

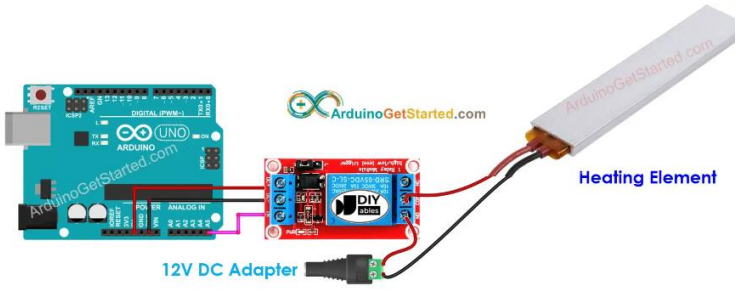

Figure 19 Heating wire circuit

4.2.7 Stepper motor driver Connection

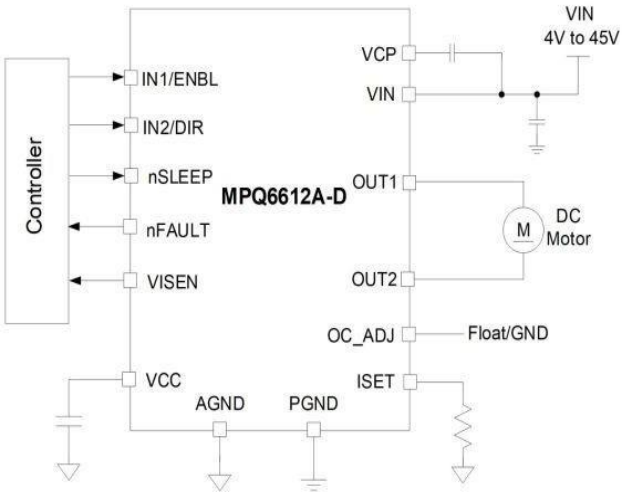

Figure 20 Stepper motor driver Connection

4.3 Mechanical Part

This subsection explores the mechanical details and parts that worktogether to deliver the output to the user. This includes the 3D printing machine.

4.3.1 Milk store:

We printed a piece to be the milk store with a mixer inside to so the milk powder does not stuck .

Figure 21 milk store

Figure 22 mixer in milk store

4.3.2 Milk mixer

The mixer goes down in the bottle and then rotate for some time so the milk powder is mixed with the water.

Figure 23 milk mixer

Chapter 5. Results and Discussions

We have built this project that has many useful features .At first,it can sterilize the milk bottle ,add milk powder inside the bottle . Secondly add hot water .Thirdly,mix the milk . Fourthly ,we capped the bottle and finally we protected the bottle from germs and microbes by surrounding the bottle. Also, we maintained the temperature at 38 since we found that it's the best milk temperature for kids until the mom takes the bottle.

Conclusion and Recommendations

Conclusion

In conclusion, the proposed infant milk bottle represents a promising and innovative solution to address the major challenges faced by mothers in the early stages of child care. Over time, it has become clear that manual labeling of infant formula imposes a significant burden on mothers, thus requiring technological intervention

Insights from studies on smart home appliances, kitchen automation and specific needs for baby care confirm the uniqueness of the proposed solutions and potential impact By automating breastfeeding, these devices promise not only increased efficiency and time savings for mothers It is also meets broad trends in home automation

Furthermore, the literature review highlighted the importance of considering cultural and social nuances in the design and implementation of such technologies, emphasizing the need for a deliberative approach emphasize their users. By addressing these factors, the proposed infant formula could fill the significant gap between current bottle-based solutions and contribute significantly to the well-being of mothers and babies.

As we move forward with the development and implementation of these new technologies, it is important to consider end-user feedback, ensure regulatory compliance, and continue to refine technology based on development needs taking place on the related sectors It also holds promise to be a significant impact on baby protection technology.

Recommendations:

It is recommended to provide parents with user manuals that will assist them in configuring and using Kiddy Milk Master. Put in place a method to keep an eye on the machine's performance all the time. This could entail software upgrades and remote diagnostics to fix any new problems and maintain the equipment operating at its best.Additionally, safety feature enhancement: Constantly look for ways to improve safety features. This can involve better feedback systems to inform users of the machine's condition, extra sensors for real-time monitoring, or automatic shutdown in the case of anomalies.

FUTURE WORK

- Integrate additional sensors to gather more data, such as water quality sensors.
- Make the design smaller so it doesn’t take big place at home.
- Give the user more options on the software application side for interacting with the system ,like cancelling and scheduling.
- Enhance user interface by developing an intuitive and user-friendly interface, potentially incorporating touchscreens or voice commands for an even more straightforward user experience.
- Implement machine learning algorithms to learn and adapt to specific user preferences over time, optimizing the milk preparation process.
- Advanced sterilization techniques :Research and implement advanced sterilization methods to ensure the highest level of safety and hygiene.
- Develop a system to get feedback to improve Kiddy Milk Master more and more.

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