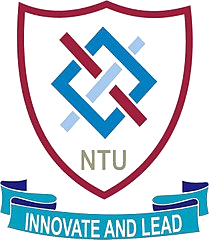
**CareNest : Where Love Meets Technology**

**(Smart cradle monitoring system)**

**24-FYP-203**



Session 2021-2025

**BACHELOR OF SCIENCE**

**IN**

**SOFTWARE ENGINEERING**

**SUBMITTED BY**

Fasih Ahmad khan 21-NTU-CS-1307

Hashim bin Hafeez 21-NTU-CS-1333

Ali Hassan 21-NTU-CS-1297

**SUPERVISED BY**

Dr. Abdul Qadeer

**CO-SUPERVISED BY**

Mam Sana Ikram

**Department of Computer Science National Textile University,**

**Faisalabad-37610, Pakistan**

**DECLARATION**

We hereby declare that this project report entitled “**CareNest** **(Smart cradle monitoring system)**” is written by us and is our effort and that no part has been copied or taken without a mentioning reference to the source.

**Group Members:**

Mr. Fasih Ahmad Khan  
21-NTU-CS-1307  
E-mail: [fasihkhan124124@gmail.com](mailto:fasihkhan124124@gmail.com)

Signature Date

Mr. Hashim bin Hafeez  
21-NTU-CS-1333   
E-mail: [H@gmail.com](mailto:H@gmail.com)

Signature Date

Mr. Ali Hassan  
21-NTU-CS-1297  
E-mail: [A@gmail.com](mailto:A@gmail.com)

Signature Date

**CERTIFICATION**

This project written by Fasih Ahmad khan(21-NTU-CS-1307), Hashim bin Hafeez(21-NTU-CS-1333), and Ali Hassan(21-NTU-CS-1297) under the direction of their supervisors and approved by all the members of the FYP committee, has been presented to and accepted by the Department of Computer Science, in the partial fulfillment of the requirement of the degree of Bachelor of Science in Software Engineering.

**Supervisor**

Dr. Abdul Qadeer Date

**Co-Supervisor**

Sana Ikram Date

**Internal Examiner**

Date

**External Examiner**

Date

**FYP-Convener**

Muhammad Shahid Date

**Head of Department**

Dr. Muhammad Asif Date

**Acknowledgement**

First of all, In the Name of **Allah**, the Most Beneficent, the Most Merciful. All the praises and thanks be to Allah. A lot of love for our beloved **Holy Prophet MUHAMMAD (S.A.W)**, his guidance always helps us to get the right path. After that, we also proudly declare that the success parameters of this project are the endless prayers and support of our parents.

We would also like to thank our supervisor, **Dr. Abdul Qadeer**, for his assistance with the project, particularly with the paperwork. Every time we meet with him, he is always ready to help us complete our project and documentation. We also wish to thank everyone who assisted us at various phases of the project.

We extend our thanks to our co-supervisor**, Mam Sana Ikram**, for her exceptional management skills. Her ability to simplify our tasks which has significantly improved our efficiency and comprehensiveness in work

We cannot miss the assistance of the **DCS services department**. Special thanks to the DCS services crew for providing us with a location to sit and work in the DCS department, as well as on-demand help. Their helpful attitude was exceptional, and it contributed significantly to the Experts' overall success.

**Abstract**

The CareNest (Smart cradle monitoring system)targets the daily trouble of parents and guardians of a baby who will be required to take care of the newborn all day while continuing to perform various tasks. Such an innovative device makes use of peripheral sensors meant to monitor all environmental surroundings as well as the condition of the baby for more extensive data so that the infant can be properly safeguarded.

It monitors continuously, checking all vital parameters for baby movement, temperature, and sound levels and giving immediate notification to the parent in case some anomaly occurs, so any future issue is rectified in the earliest stage itself.

A high-definition live-streaming video allows parents to access a direct visual feed of their infant, giving them peace of mind and allowing them to spend quality time even when they are not in the same location as the child.

The system is designed to automatically send notifications. The system easy-to-use interface, through which parents can check the status of their baby. This will be helpful for busy parents who need to juggle several things at once.

Table of Contents

[Chapter 1 9](#_Toc186879441)

[1: Introduction 9](#_Toc186879442)

[1.1: Problem Statement: 9](#_Toc186879443)

[1.1.1: Neglecting other tasks: 9](#_Toc186879444)

[1.1.2: Compromised Health: 9](#_Toc186879445)

[1.1.3: Financial Strain: 9](#_Toc186879446)

[1.2: Proposed Solution: 9](#_Toc186879447)

[1.3: Purpose: 10](#_Toc186879448)

[1.4: Project Goal: 10](#_Toc186879449)

[1.5: Project Objectives: 10](#_Toc186879450)

[1.5.1: Hardware Development: 10](#_Toc186879451)

[1.5.2: Software Development: 10](#_Toc186879452)

[1.6: Project Scope: 11](#_Toc186879453)

[1.6.1: Target Audience: 11](#_Toc186879454)

[1.6.2: Features: 11](#_Toc186879455)

[1.6.3: Scalability: 11](#_Toc186879456)

[1.7: Proposed Tools and Technologies: 11](#_Toc186879457)

[1.7.1: Software: 11](#_Toc186879458)

[1.7.2: Hardware: 12](#_Toc186879459)

[1.8: Project Scheduling: 13](#_Toc186879460)

[Chapter 2 14](#_Toc186879461)

[2.1: Literature Overview 14](#_Toc186879462)

[2.2: Related Work: 14](#_Toc186879463)

[2.2.1: VTech Upgraded Smart Wi-Fi Baby Monitor 14](#_Toc186879464)

[2.2.2: Ellie Smart Baby Monitor 14](#_Toc186879465)

[Comparison with existing technologies: 15](#_Toc186879466)

[Chapter 3 17](#_Toc186879467)

[3: System Requirements 17](#_Toc186879468)

[3.1: Functional Requirements: 17](#_Toc186879469)

[3.1.1: User Signup 17](#_Toc186879470)

[3.1.1.1: User Registration: 17](#_Toc186879471)

[3.1.1.2: Password Strength: 17](#_Toc186879472)

[3.1.2: User Login 17](#_Toc186879473)

[3.1.2.1: Login Credentials: 18](#_Toc186879474)

[3.1.2.2: Password Recovery: 18](#_Toc186879475)

[3.1.2.3: Session Management: 18](#_Toc186879476)

[3.1.3: Temperature Monitoring 18](#_Toc186879477)

[3.1.3.1: Real-time Temperature Display: 18](#_Toc186879478)

[3.1.3.2: Temperature Alert: 18](#_Toc186879479)

[3.1.4: Air Quality Index Monitoring 18](#_Toc186879480)

[3.1.4.1: AQI Display: 18](#_Toc186879481)

[3.1.4.2: AQI Alert: 18](#_Toc186879482)

[3.1.5: Weight Monitoring 19](#_Toc186879483)

[3.1.5.1: Weight Tracking: 19](#_Toc186879484)

[3.1.5.2: Baby Presence Detection: 19](#_Toc186879485)

[3.1.6: Lullaby Speaker Control 19](#_Toc186879486)

[3.1.6.1: Lullaby Playback: 19](#_Toc186879487)

[3.1.7: Live Camera Streaming 19](#_Toc186879488)

[3.1.7.1: Video Streaming: 19](#_Toc186879489)

[3.1.7.2: Secure Access: 19](#_Toc186879490)

[3.1.8: Notification System 19](#_Toc186879491)

[3.1.8.1: Real-time Alerts: 19](#_Toc186879492)

[3.1.8.2: Customizable Notifications: 19](#_Toc186879493)

[3.1.9: Mobile Application Access 19](#_Toc186879494)

[3.1.9.1: User-Friendly Interface: 19](#_Toc186879495)

[3.1.10: Secure Data Handling 20](#_Toc186879496)

[3.1.10.1: Data Encryption: 20](#_Toc186879497)

[3.1.10.2: Secure Authentication: 20](#_Toc186879498)

[3.1.10.3: Data Privacy: 20](#_Toc186879499)

[3.1.11: Diaper Changing alert 20](#_Toc186879500)

[3.1.11.1: Change Alert: 20](#_Toc186879501)

[3.2: Non-Functional Requirements: 20](#_Toc186879502)

[3.2.1: Usability 20](#_Toc186879503)

[3.2.2: System Performance 20](#_Toc186879504)

[3.2.3: Security 20](#_Toc186879505)

[3.2.4: Availability 20](#_Toc186879506)

[3.2.5: Reliability 21](#_Toc186879507)

[3.3: Use Case Diagram: 21](#_Toc186879508)

[Use Case Description: 22](#_Toc186879509)

[Chapter 4 26](#_Toc186879510)

[4: Methodology 26](#_Toc186879511)

[4.1: Methodologies for Software Development: 26](#_Toc186879512)

[4.1.1: Waterfall Model: 26](#_Toc186879513)

[4.1.2: V Model: 27](#_Toc186879514)

[4.1.3: incremental Model: 28](#_Toc186879515)

[4.1.4: Iterative Model: 29](#_Toc186879516)

[4.1.5: Agile Model: 30](#_Toc186879517)

[4.1.6: RAD Model: 31](#_Toc186879518)

[4.2: Selected Methodology: 31](#_Toc186879519)

[4.3: Reasons for Selecting the Methodology: 31](#_Toc186879520)

[4.3.1: Adaptability to change: 32](#_Toc186879521)

[4.3.2: Incremental Development: 32](#_Toc186879522)

[4.3.3: User Feedback and Involvement: 32](#_Toc186879523)

[4.3.4: Flexibility: 32](#_Toc186879524)

[4.4: Conclusion: 32](#_Toc186879525)

# Chapter 1

# 1: Introduction

## 1.1: Problem Statement:

Supervising and monitoring an infant is a major challenge in the life of a parent. Parents often find it difficult to supervise their newborn child for the whole day. On the other hand, a newborn child requires proper attention and supervision to make sure that they are healthy and safe. This challenge in parenting life is unavoidable as even a stay-at-home parent cannot attend to the infant for 24 hours. This challenge encourages other problems to arise such as difficulty in performing one’s assigned tasks, hindrance in daily life chores, lack in productivity, etc. This challenge leads to the following problems in daily life of a parent:

### 1.1.1: Neglecting other tasks:

An infant-attending parent is more likely to miss the other tasks assigned to them as only this task requires 100 percent attention of them.

### 1.1.2: Compromised Health:

This challenge poses risk to the health of both parent and child as doing supervision for a whole day can be stressful for the parent and not doing it properly can cause issues with the infant.

### 1.1.3: Financial Strain:

Attending to an infant may hinder one’s financial activities. Hiring a babysitter is also a financial burden on a parent’s account.

## 1.2: Proposed Solution:

We propose to design a CareNest (Smart cradle monitoring system)that overcomes all the problems faced by the parents. The system would utilize advanced technologies such as IoT for real-time video and audio monitoring, alerts, and monitoring the environmental factors. Major features of the system include:

* **Video streaming:** Real-time visual of the baby's activities.
* **Smart alerts**: Alert generation on time to events. the system will also enable alerts management
* **Baby temperature and humidity monitoring:** Maintain the baby environment
* **Mobile application:** for the user-friendly interface to control and monitor.
* **High-end security and privacy features:** Protects sensitive data and ensures the safety of the baby.

Providing these features, our solution will help parents remain connected to the baby and allow them to relax knowing the baby is in good care when they are away.

## 1.3: Purpose:

The main purpose of this project is to solve daily life problems faced by parents that they face while caring for their child. It aims to enable parents to keep an eye on the infant remotely and to make sure that their infant is safe while they are not attending physically.

## 1.4: Project Goal:

**To develop a reliable and user-friendly remote baby monitoring system that enhances parental peace of mind and ensures the safety and well-being of infants.**

## ****1.5: Project Objectives:****

**The objectives of this project are as follows:**

### ****1.5.1: Hardware Development:****

* Design and develop a robust hardware system, including a camera, sensors, and a processing unit.
* Implement secure wireless connectivity for reliable data transmission.

### ****1.5.2: Software Development:****

* Develop a user-friendly mobile application.
* Implement real-time video streaming with low latency.
* Ensure secure data transmission and storage.

**1.5.3: User Interface Design:**

* Create a visually appealing user interface for the mobile app.
* Design clear and concise notifications to alert parents of important events.

## 1.6: Project Scope:

Scope of this project is as follows:

### 1.6.1: Target Audience:

This project initially targets the persons with parenting responsibilities(Parents, Caretakers, Babysitters, Nannies).

### 1.6.2: Features:

This project includes core functionalities like video camera surveillance, temperature detection for fever alerts, noise detection for cry alerts, audio content for calming the infant, and humidity detection for ensuring a healthy environment.

### 1.6.3: Scalability:

This system is designed with scalability in mind, allowing for future expansion to monitor multiple cradles simultaneously. This feature makes it suitable for deployment in various settings, including hospital nurseries and daycare centers.

## 1.7: Proposed Tools and Technologies:

Following tools and technologies are proposed for development of this project:

### 1.7.1: Software:

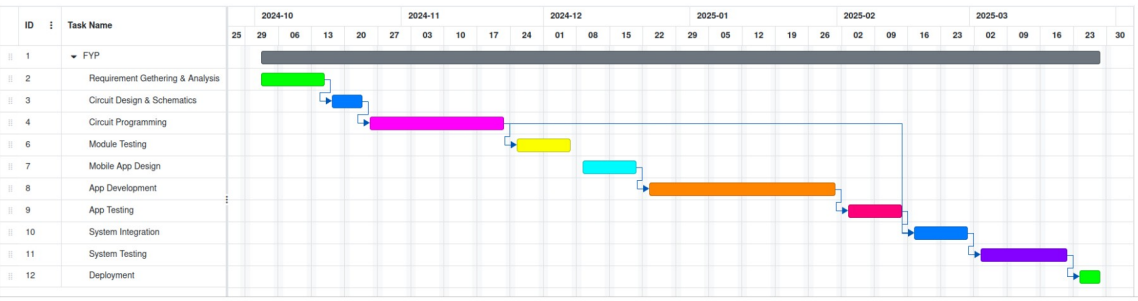
1. **Figma** – Used for designing the user interface (UI) and user experience (UX) of the mobile application.
2. **Android Studio** – IDE used to manage and run the Flutter-based mobile application on Android devices.
3. **Flutter** – Cross-platform development framework used to build the mobile application with a single codebase.
4. **Dart** – Programming language used with Flutter to implement the app's logic and UI.
5. **Firebase** – Backend-as-a-Service (BaaS) platform used for real-time database, authentication, and notifications.
6. **Trello** – A project management tool used to organize tasks, track progress, and collaborate effectively.

### 1.7.2: Hardware:

1. **PlatformIO + VSCode** – Development environment for writing and debugging embedded system code for IoT devices.
2. **Microcontroller**:
   * **Espressif ESP32-WROVER** – The core microcontroller unit that processes data from sensors and modules, enabling IoT functionality.
3. **Sensors and Modules**:
   * **Weight Measurement:** HX-711 module with load cells (15kg capacity) for monitoring the baby’s weight in the cradle.
   * **Temperature Monitoring**:
     + DS18B20 (Probe) – Measures the ambient temperature with high accuracy.
     + MLX90614 (IR) – Measures non-contact temperature, such as the baby’s forehead or the cradle's surface.
   * **Noise Detection**: MAX9814 microphone module to monitor noise levels around the baby.
   * **Air Quality Index (AQI)**: MQ-135 sensor to monitor air quality and detect harmful gases.
4. **Audio System**:
   * **DFPlayer Mini** – A compact MP3 player module for playing lullabies and soothing sounds.
   * **8-ohm Speaker** – Outputs the audio from the MP3 player module.
5. **Camera**:
   * **ESP32-CAM** – A camera module integrated with the ESP32 microcontroller to provide live video streaming of the baby in the cradle.

## 1.8: Project Scheduling:

We use Gantt Chart to show the overall schedule of the project, the starting and ending time and time duration, each activity takes. So, here is the Timeline of the project shown by a Gantt chart in table



# Chapter 2

## 2.1: Literature Overview

This chapter will undertake a critical review of the existing systems and technologies related to our project. We will analyze applications currently in use by a wide range of end-users and stakeholders, highlighting their limitations and shortcomings. Analyzing these existing solutions, we will be able to identify the essential features lacking in current offerings and which are thus critical for our proposed system to effectively meet the identified needs.

## 2.2: Related Work:

The systems on the market currently are mostly environment centric. These systems help parents to smartly monitor their baby, but they are not very effective as their primary focus is to monitor the environment in which the infant is residing rather than focusing on the newborn. They share various common traits with our system, but they have various drawbacks too that are being addressed by our system. However, here we will dig into discussion of such two systems.

### 2.2.1: VTech Upgraded Smart Wi-Fi Baby Monitor

Owned by V-Tech store, this system is labeled as a baby monitoring system but is primarily developed to be an indoor security system for households. It has its own monitoring screen that relates to a camera with two-way audio communication, Temperature sensors for environment not for baby temperature , Lullaby activation, night vision, etc. It’s a plug and play system and just includes a monitor and a camera.

### 2.2.2: Ellie Smart Baby Monitor

Developed by EllieHello, this system is a smart baby monitoring system which allows features like live video streaming, two-way audio communication, mobile application, night vision, etc. This product is widely used for infant monitoring, and it has a plus point of having a mobile app that eliminates the need for a dedicated screen.

## Comparison with existing technologies:

Table 2.1 shows the comparison between the three existing technologies and our system.

|  |  |  |  |
| --- | --- | --- | --- |
| **Features** | **Technologies** | | |
| **Vtech Baby Monitor** | **Ellie Smart Monitor** | **Our Work** |
| Temperature Sensor | Measures Temperature of the Environment | Measures Temperature of the Environment | Measures Temperature of the Infant |
| Noise Detector | Yes | Yes | Yes |
| Air Quality Check | No | No | Yes |
| Spoiled Diaper Detection | No | No | Yes |
| Live Stream | Yes | Yes | Yes |
| Play Lullabies | Yes, but not automated | Yes, and automated | Yes, and automated |
| Baby Presence Detection | No | No | Yes |
| Mobile Application | No | Yes | Yes |
| Notification Alerts | No | Yes | Yes |

Reasons to Develop:

There are numerous reasons that have led to the development of this system. A major factor is limitations in the previously existing systems coupled with increasing necessity.

Following are reasons for development of this system:

* The technologies mentioned above are more focused on the environment than they are on the infant. This factor molds them into more of surveillance systems than baby monitoring systems. The core focus of our system is to monitor the infant's state rather than the environment, ensuring the best possible care for the baby.
* Most baby monitoring systems available on the market require users to purchase a special monitor screen that interacts with the system's features. Our system offers application access to these features, installable on the user's mobile phone. This eliminates the need for extra equipment, making it simpler, more efficient, and cost-effective.
* The user interface of our application is simple and intuitive, allowing even naive users to easily operate it without any prior training.

In short, we are designing this system to prioritize infant welfare by focusing on their state instead of just monitoring the environment and providing a user-friendly mobile application that does not require extra hardware.

# Chapter 3

# 3: System Requirements

This document outlines the detailed system requirements for the CareNest (Smart cradle monitoring system)application. It defines the functional and non-functional requirements that the system must meet to satisfy the business needs. These requirements serve as the foundation for the system's design, development, and testing phases.

# 3.1: Functional Requirements:

Following are the functional requirements for the system:

## 3.1.1: User Signup

### 3.1.1.1: User Registration:

The system shall allow new users to create accounts by providing the following information:

* Email address
* Password

### 3.1.1.2: Password Strength:

The system shall enforce password strength requirements, including minimum length of 8 character, and unique character usage.

## 3.1.2: User Login

### 3.1.2.1: Login Credentials:

The system shall allow users to log in using their registered username or email address and password.

### 3.1.2.2: Password Recovery:

The system shall provide a password recovery feature that allows users to reset their password by entering their registered email address.

### 3.1.2.3: Session Management:

The system shall maintain user sessions and automatically log out users after a period of inactivity.

## 3.1.3: Temperature Monitoring

### 3.1.3.1: Real-time Temperature Display:

The system shall display the current temperature of the baby's body in real-time on the user interface.

### 3.1.3.2: Temperature Alert:

The system shall send an alert notification to the user if the temperature exceeds or falls below predefined Health medical thresholds.

## 3.1.4: Air Quality Index Monitoring

### 3.1.4.1: AQI Display:

The system shall display the current presence of hazardous gases like Carbon Monoxide (CO), Nitrogen Oxides (NOx), Ammonia (NH3), Volatile Organic Compounds (VOCs) individually. Ensuring safe air for the baby.

### 3.1.4.2: AQI Alert:

The system shall send an alert notification to the user if the AQI reaches an unhealthy level.

## 3.1.5: Weight Monitoring

### 3.1.5.1: Weight Tracking:

The system shall monitor the weight on the cradle's sensor and record the data.

### 3.1.5.2: Baby Presence Detection:

The system shall detect the presence of the baby based on weight changes on the cradle's sensor.

## 3.1.6: Lullaby Speaker Control

### 3.1.6.1: Lullaby Playback:

The system shall allow the user to remotely pause and play lullabies through the cradle's speaker.

## 3.1.7: Live Camera Streaming

### 3.1.7.1: Video Streaming:

The system shall provide a live video feed from the cradle's camera to the user's device.

### 3.1.7.2: Secure Access:

The system shall implement secure authentication and authorization mechanisms to restrict access to the video feed to authorized users.

## 3.1.8: Notification System

### 3.1.8.1: Real-time Alerts:

The system shall send real-time notifications to the user's mobile device for any anomalies in temperature, AQI, weight, or humidity.

### 3.1.8.2: Customizable Notifications:

The system shall allow users to customize notification settings, including:

* Notification frequency
* Types of alerts (e.g., push notifications, email, SMS)

## 3.1.9: Mobile Application Access

### 3.1.9.1: User-Friendly Interface:

The mobile app will provide a user-friendly interface for accessing all monitoring features and controlling the cradle's functionalities.

## 3.1.10: Secure Data Handling

### 3.1.10.1: Data Encryption:

The system shall encrypt all sensitive data, including personal information and health data, during transmission and storage.

### 3.1.10.2: Secure Authentication:

The mobile app shall implement strong authentication mechanisms, such as password-based authentication and optional two-factor authentication.

### 3.1.10.3: Data Privacy:

The system shall comply with relevant data privacy regulations and protect user data from unauthorized access.

## 3.1.11: Diaper Changing alert

### 3.1.11.1: Change Alert:

The system shall send an alert notification to the user when the diaper is contaminated and needs changing.

# 3.2: Non-Functional Requirements:

These are considered to be prerequisites for performance. Usually, these are not required by users but provided to satisfy investors and meet standard quality

## 3.2.1: Usability

The system’s interface should be easy to use.

## 3.2.2: System Performance

The system should provide timely notifications and updates and operate with efficiency.

## 3.2.3: Security

The system should provide appropriate safety measures to protect user data.

## 3.2.4: Availability

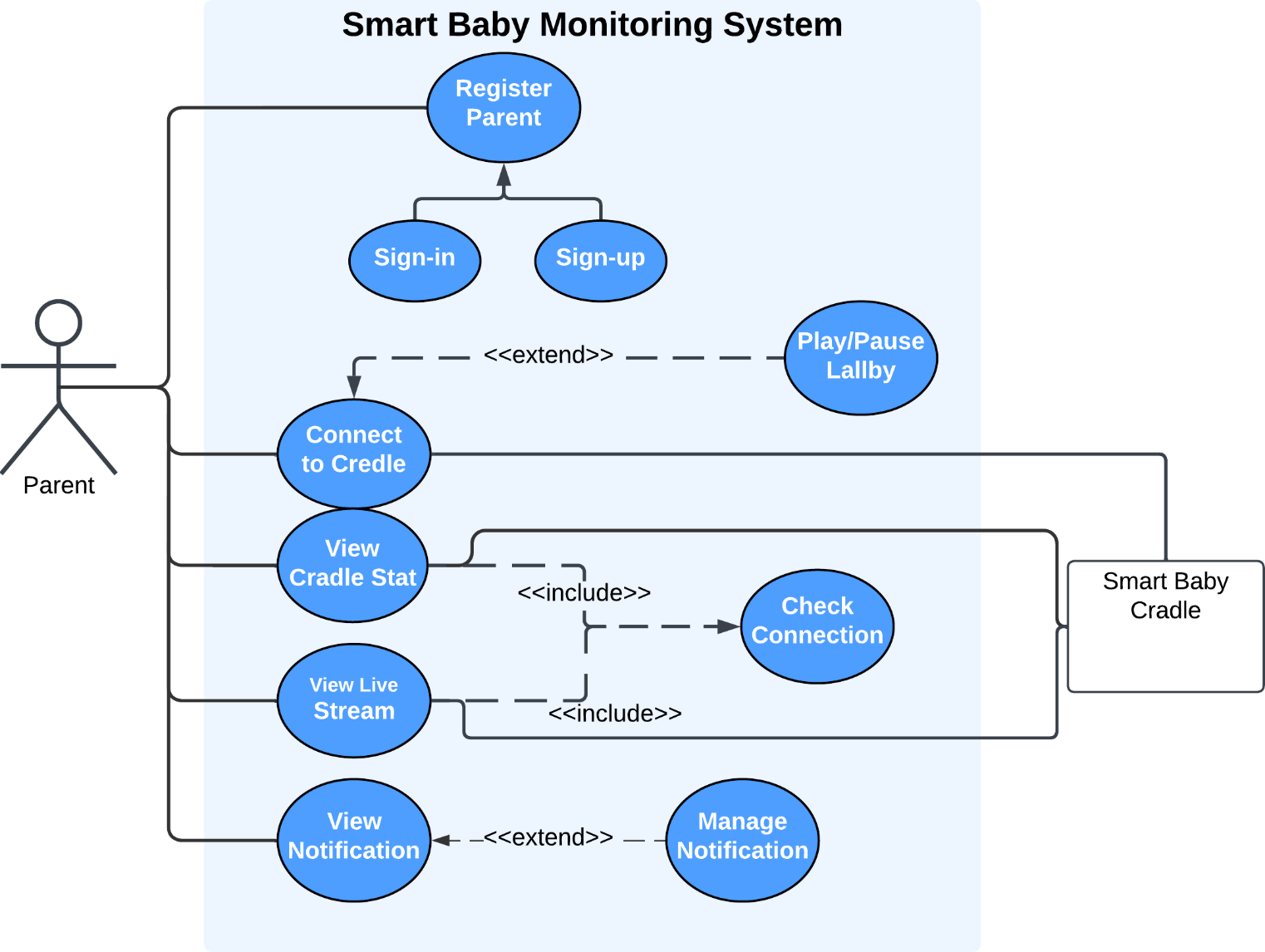
Ensure that there is little downtime for upgrades or maintenance and that the system is available and functioning around-the-clock.

## 3.2.5: Reliability

The system should be trustworthy, precisely detecting baby environment and generating accurate data.

# 3.3: Use Case Diagram:

The most suitable method for visualizing how actors interact with system components is to create use case diagrams, which visually depict which actors can access or perform which system functionality. Figure 3.1 shows the use case diagram for the system:



## Use Case Description:

|  |  |
| --- | --- |
| **Use Case Id** | 1 |
| **Use Case Name** | Register Parents/Sign-Up |
| **Actors** | Parents |
| **Use Case Description** | Allow new users to get registered in the system, will ask for details of the user like name, password. |
| **Pre-Condition** | No existing account associated with the provided information. |
| **Post-Condition** | User account is created, and the user is logged in. |

|  |  |
| --- | --- |
| **Use Case Id** | 2 |
| **Use Case Name** | Log In |
| **Actors** | Parents |
| **Use Case Description** | The system will ask the user to enter his/her id and password to get access to the system. |
| **Pre-Condition** | No existing account associated with the provided information. User is registered and has valid credentials (username/password). |
| **Post-Condition** | User is authenticated and directed to his/her appropriate dashboard or resets the password. |

|  |  |
| --- | --- |
| **Use Case Id** | 3 |
| **Use Case Name** | Connect to Cradle |
| **Actors** | Parents |
| **Use Case Description** | The user will link the app with the cradle via wireless connections like WiFi or Bluetooth. |
| **Pre-Condition** | User is logged In using a valid username and password. |
| **Post-Condition** | User is able to access features of the app. |

|  |  |
| --- | --- |
| **Use Case Id** | 4 |
| **Use Case Name** | View Cradle Stat |
| **Actors** | Parents |
| **Use Case Description** | The app interface will show user the real-time data coming from the cradle sensors. |
| **Pre-Condition** | User is logged In using a valid username and password and the cradle is connected with the app. |
| **Post-Condition** | User is able to access features of the app. |

|  |  |
| --- | --- |
| **Use Case Id** | 5 |
| **Use Case Name** | View Live Stream |
| **Actors** | Parents |
| **Use Case Description** | The user will view the live stream video coming from cradle camera. |
| **Pre-Condition** | User is logged In using a valid username and password and the cradle is connected with the app. |
| **Post-Condition** | User is able to access features of the app. |

|  |  |
| --- | --- |
| **Use Case Id** | 6 |
| **Use Case Name** | View Notifications |
| **Actors** | Parents |
| **Use Case Description** | The user will view the notifications or alerts generated by the app based on the real-time data coming from the sensors. |
| **Pre-Condition** | User is logged In using a valid username and password and the cradle is connected with the app. |
| **Post-Condition** | User is able to access features of the app. |

|  |  |
| --- | --- |
| **Use Case Id** | 7 |
| **Use Case Name** | Manage Notifications |
| **Actors** | Parents |
| **Use Case Description** | The use will be able to enable and disable notifications from certain sensors. |
| **Pre-Condition** | User is logged In using a valid username and password and the cradle is connected with the app. |
| **Post-Condition** | User is able to access features of the app. |

# Chapter 4

# 4: Methodology

This chapter covers the project lifecycle, which includes feasibility study and detailed project schedule. We will discuss several software development methodologies that are important to the successful delivery of software. This part will review the existing methodologies, the methodology selected for our project, and its implementation flow that will lead to a detailed project schedule. Let us start by discussing the current landscape of existing software development methodologies.

## 4.1: Methodologies for Software Development:

A software development methodology acts as an outline for developing efficiency within the process of development in a series of well-articulated steps. Productivity improves with this methodology, along with better management of systems. These sets of methodologies, commonly called the SDLC, embrace a set of phases defined by its rules. Two major methodologies can be differentiated: there are two kinds of it, namely, Rapid Application Development, and Plan-Driven. While Waterfall and Spiral models are classed as Plan-Driven, Agile methodologies fall in the category of RAD.

### 4.1.1: Waterfall Model:

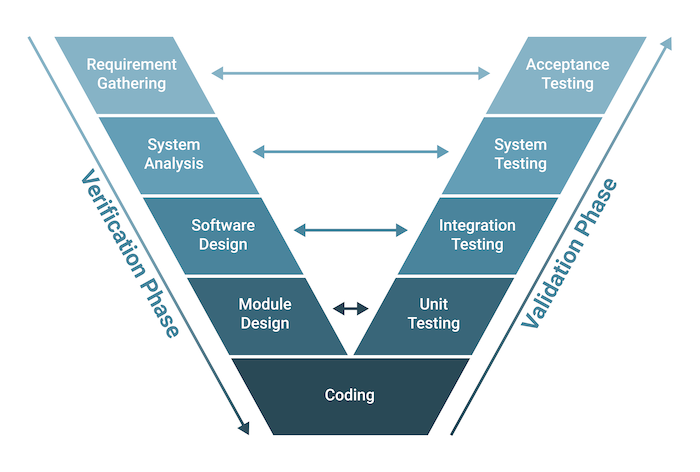
The project uses the Waterfall Model, one of the traditional, linear approaches for developing software. It breaks up the project into distinct phases. One of the distinct features of the Waterfall Model is its sequential nature; no phase can be skipped once completed, making it impossible to implement changes to the phase once it is concluded, hence the name "Waterfall" – each phase cascades into the next. In the long run, significant cost and time savings will be achieved if requirements and design are emphasized at the beginning stages of the Waterfall Model.

A diagram of a waterfall model

Description automatically generated

### 4.1.2: V Model:

The V-model is a derivative of the Waterfall model emphasizing the strong correlation between the testing activities and the related analysis and design phases. Like Waterfall, it follows the sequential approach, where each stage must be completed before starting the next one. Nevertheless, the V-model is more unique in that it maintains a separate testing phase at every stage of the Waterfall model, which gives it a look like a "V.". Unit and system testing within this framework serve to validate the design of the program, checking whether individual components are correctly functioning and whether the whole system works.



### 4.1.3: incremental Model:

The Incremental Model is a software development approach where the big picture of the project is divided into numerous smaller sub-projects that could be easily handled. Dividing the system into groups of functionalities, this module goes through the full life cycle of the process starting from gathering requirements to actual design, implementation, and testing. After that, subsequent releases add incrementally new features and functionalities added to the basic subsystem introduced in the early releases.

A diagram of a software development process

Description automatically generated

### 4.1.4: Iterative Model:

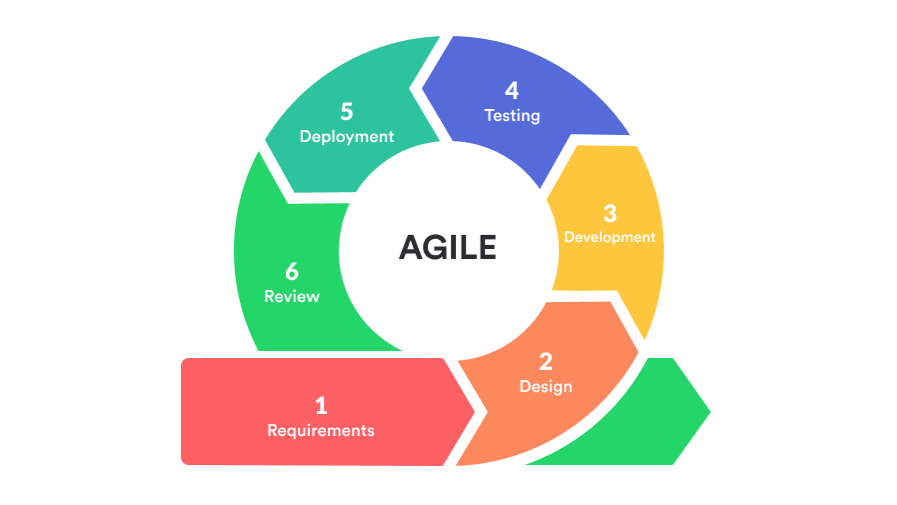
The Iterative Model is a software development approach that breaks the project into smaller cycles known as iterations. Each iteration of the model covers the full lifecycle of software development. Iterative development encourages continuous improvement, giving a working system in the first release and then continues to improve the functionality of each subsystem with each release. This model focuses on continuous testing, which allows project evaluation to be done continuously throughout the project and distributes the work more evenly over the time of the project.

A diagram of a diagram

Description automatically generated

### 4.1.5: Agile Model:

Agile process models are a software development approach based on iterative development principles. Unlike traditional methods with extensive long-term planning, Agile methodologies break down tasks into smaller, more manageable iterations. While the project scope and initial requirements are established at the outset, Agile emphasizes flexibility. The number of iterations, their duration, and the scope of each iteration are typically defined with greater clarity at the commencement of the development process.



### 4.1.6: RAD Model:

The Rapid Application Development (RAD) model is an incremental software development process that focuses on prototyping and iterative user feedback instead of extensive upfront planning and comprehensive testing. RAD is especially designed to accelerate software delivery within short timeframes with emphasis on user involvement and iterative refinement throughout the development cycle.

A diagram of a rad prototype

Description automatically generated

## 4.2: Selected Methodology:

In the current project, we selected the Agile Process Model because it offers more benefits than the other methods, which shall be described in the succeeding discussion.

## 4.3: Reasons for Selecting the Methodology:

The following are the most important reasons why we opted for the Agile method:

## 4.3.1: Adaptability to change:

Agile methodologies, by definition, are adaptable to any change of requirement, hence able to adjust in responding rapidly to any changes at work and ensure successful input from clients.

## 4.3.2: Incremental Development:

Agile supports incremental development, meaning functional increments can be delivered at the end of each iteration or sprint. This means that a tangible, functional prototype is seen early in the project cycle and stakeholders are given the chance to review and provide very valuable feedback.

## 4.3.3: User Feedback and Involvement:

Agile encourages constant communication and collaboration between the stakeholders and end-users during development. More frequent feedback sessions ensure necessary adjustments, thereby leading to continuous improvement towards a final product that is much closer to the needs of the user.

## 4.3.4: Flexibility:

Agile allows feature prioritization to be adjusted dynamically based on changing business needs or evolving requirements. This will ensure that the development team will focus on the most valuable and impactful features at any point in time.

## 4.4: Conclusion:

The Agile software development process is well-suited for this project due to its emphasis on flexibility, adaptability, and collaborative teamwork.