Chapter 1

INTRODUCTION

1.1 BACKGROUND

Industrialization has been beneficial for women. It increased female participation in labor outside the home. Subsequently, infant care has become a challenge to many families in their daily life. Mother is always worried about the well being of her baby while working.

In India both the parents need to work and look after their babies/infants, so more workload and stress is there on such families especially on female counterparts. If system is developed which continuously gives updates about their infants during illness or during normal routine then it will be of great help to such members as they can work in stress less environment giving more fruitful output. Also urgent situation condition can be quickly noticed and handled within less time.So there has to be a system which can monitor the activities of the babies and/or infants to measure the health parameters and give this information to their parents.

There are different monitoring systems available at the hospitals but sometimes it is also necessary to take care of the baby at home. Conventional approaches of monitoring the infant includes constant monitoring on infant using web camera or keeping nurse for the baby.

This system will give a peace of mind to parents when they are away from their infant as they can get an update status of baby's well being. The other advantage is the programmability of alarm conditions can alleviate any inaccuracy through a normal sensor.Communication is done by GSM interface in which Short Messaging Service (SMS) is fundamental part of the original GSM system and its progress.

1.2 PROBLEM STATEMENT

To develop a system which can efficiently monitor the health of infant and can robustly provide notifications as well as additional information to control the situation and take

appropriate actions to ensure well beingness of the baby.

1.3 PURPOSE

The aim of the project is to build a system which can efficiently monitor health of baby and keep parents stress free.

1.4 SCOPE

This system can be used at home where in the parents can monitor or track their baby's health even when they are at work or outside their home.This project will also help to monitor the health of babies in the hospitals, which will help the doctors and ease their work.

Chapter 2

LITERATURE SURVEY

2.1 PRESENT WORK

- **Andre G. Ferreira et.al A Smart Wearable System for Sudden Infant Death Syndrome Monitoring,** SIDS i.e. Sudden Infant Death Syndrome is one of the major causes of death among infants during sleep. The wearable IoT device is a wireless sensor node integrated in a chest belt, and it monitors parameters such as body temperature, heart and breathing rates and body position. If critical event occurs, the device will trigger an alarm, visible and audible in the proximity and sends a distress message to a mobile application.[1]

- **Mairo Leier et.al Miniaturized Wireless Monitor for Long-term Monitoring of Newborns,** Wireless infant monitoring system is a small size wearable sensor platform.In this paper, they proposed a monitoring system that detects the most important vital signals of baby and transmits results over wireless link to the control device that could be any smart phone. By measuring the raw signals, it is possible to use this system in different, possible life threatening situations during long term monitoring.[2]

- **Angelo M. Fonseca et.al A Sudden Infant Death Prevention System for Babies,** the Sudden Infant Death Syndrome (SIDS) is an expert diagnosis when an apparently healthy baby dies without explanation. This paper proposes a mobile solution based on biofeedback monitoring that tries to prevent the sudden death in infants. When an issue is detected by this system, it sends a warning to those responsible for the baby. Mobile devices are used to process the sensed data and monitoring baby and performing alerts/ warnings when an abnormal situation is detected.[3]

- **Savita P. Patil et.al Intelligent Baby Monitoring System,** this system monitor vital parameters such as body temperature, pulse rate, moisture condition, movement of an infant and using GSM network this information is transferred to their parents. Measurements of these vital parameters can be done

and under risk situation conveyed to the parents with alarm triggering system to initiate the proper control actions.The system architecture consist of sensors for monitoring vital parameters, LCD screen, GSM interface and a sound buzzer all controlled by a single micro controller core.[4]

- **Octavian Dospinescu et.al Implementing Monitoring Systems in Mobile Applications a Case Study,** In this paper, a case study is presented for a monitoring system using the Android platform and the benefits of computer networks. We use the power of mobile sockets and mobile threads, integrating them in a complex architecture in order to obtain a real monitoring system. As an immediate application, we propose a baby monitoring systems so that the children could be remotely supervised by their parents. The case study is based on Android mobile client-server architecture and also uses the capabilities offered by the phones speaker and microphone. [5]

- **V.Ramya et.al Embedded Patient Monitoring System,** the aim of this project is to inform the doctor about the ICU patient condition through wireless. For the medical professionals it becomes important to continuously monitor the conditions of a patient. This project provides a device which will continuously monitor the vital parameters to be monitored for a patient and do data logging continuously. If any critical situation arises in a patient, this unit also raises an alarm and also communicates to the concerned doctor by means of an SMS to the doctor.[6]

- **G. Rajesh et.al Baby Monitoring System Using Wireless Sensor Networks,** Sudden Infant Death Syndrome (SIDS) is marked by the sudden death of an infant during sleep that is not predicted by the medical history and remains unexplained even after thorough forensic autopsy and detailed death investigation. In this a system is developed that provides solutions for the above problems by making the crib smart using the wireless sensor networks (WSN) and smart phones. The system provides visual monitoring service through live video, alert services by crib fencing and awakens alert, monitoring services by temperature reading and light intensity reading, vaccine reminder and weight monitoring.[7]

- **Yedu Manmadhan et.al Remote Patient Monitoring System,** this paper provides an image based techniques to acquire and analyze a constant streaming of ECG signal through digital camera for image capturing, information extraction and analysis performed using MATLAB tools as well as data sending system based on Internet network. The method captures the vital signs and parameters from the ICU monitoring machine using a webcamera and transmits the image through the Internet. This original image is then availed to the consulting doctor via an ANDROID cell phone. In case of anomaly a notification is send to the doctors phone. The paper proposes a method to capture, compare and

generate alert regarding the patients condition using the heart rate and make the captured image be available to the physician.[8]

- **Suresh B et.al Advanced Baby Care System,** constant monitoring of the child also becomes a necessity, especially up to an age of 18 months. In his work, a mobile robotic device has been designed and developed. This device can help a parent to keep track of their baby and its surroundings without having to check on the baby every now and then. Advanced Baby Care System (ABCS) has a Master Controller (Arduino Mega 2560), which integrates all the different modules of the robot by receiving the necessary signals from the sensor modules and sending signals to the trigger alarm and the DC motors. It is a micro controller board based on the ATmega328. This board can be easily interfaced with the CMUCam5 module, used for tracking, as well as other sensors which are being used in the project. ABCS is an intelligent, baby friendly system, which integrates many functions into a single device, automatically alerting the parent when it is necessary and allowing them to carry on with their activities uninterrupted. [9]

- **Chanakya Mothukuri et.al Patient Monitoring System,** in present days, real-time monitoring of the physical condition of the patients is one of the major challenges faced by hospital authorities. Here, a Patient monitoring system is implemented which will be one of the major improvements in the hospitals. All the hospitals today have the monitoring systems which are wired. Also human intervention is needed frequently for critical patients. In this paper, Proposed system i.e. PMS (Patient Monitoring System)is operated wirelessly. This wireless patient monitoring system in this paper measures heartbeat, body temperature and percentage of oxygen in blood. This paper discusses about the design and development of a low cost apparatus which uses GSM technology for monitoring the health condition of the patient. [10]

Sr.No.	Author	Paper	Idea
1	Andry G. Ferreira , Duarte Fernandes , Syrgio Branco	A smart wearable system for sudden infant death syndrome monitoring	Monitors parameters through the chest belt.
2	Mairo Leier , Gert Jervan	Miniaturized wireless monitor for long-term monitoring of newborns	Detects vital signals baby and transmit using wireless link.
3	Angelo M. Fonseca , Edgar T. Horta , Sandra Sendra , Joel J. P. C. Rodrigues, J. A. F. Moutinho	A Sudden Infant Death Prevention System for Babies	Uses biofeedback monitoring through mobile.
4	Savita Patil, Manisha Mhetre	Intelligent Baby Monitoring System	Monitor vital health parameters and transfer using GSM network to their parents.
5	Octavian Dospinescu, Roxana-Marina Strainu	Implementing Monitoring Systems in Mobile Applications a Case Study	Monitoring system using Android platform and remotely monitor children.
6	V.Ramya, B.Palaniappan, Anuradha Kumari	Embedded Patient Monitoring System	A device will continuously monitor vital parameters and sends SMS.
7	G. Rajesh, R. Arun Lakshman, L. Hari Prasad, R. Chandira Mouli	Baby Monitoring System Using Wireless Sensor Networks	Crib is made smart using WSN and smart phones. Live video and alert services are provided.
8	Neethu Rachel Jacob, Yedu Manmadhan, Anand V. R., M. J. Jayashree	Remote Patient Monitoring System	Image based techniques are used for constant streaming of ECG signal
9	Suresh B, Ramaprasad P, Mariyam M, Abdul J	Advanced Baby Care System	Robot receives necessary signals using sensors and sends signals to trigger alarm.
10	Chanakya Mothukuri, K. CH. Prathap Kumar	Patient Monitoring System	This system is operated wirelessly and it measures heartbeat, temperature and oxygen level.

2.2 PROPOSED WORK

Our system will be detecting unexpected events by registering several physiological parameters.It will be a reliable real time monitoring system for infants which will be wireless. We will try to miniaturize the system, improving the comfort for the baby. Sensors will be connected to a hardware unit using Bluetooth.

The mobile application will present data graphically in real time to parents on their smart phones. Pulse rate and Oximetry sensors will be used to take measurements and GSM can be used to send SMS.Sensors will be connected to controllers directly and they will communicate wirelessly to centralized cloud server.Technology such as 3G will provide higher data transmission speed.

Chapter 3

SOFTWARE REQUIREMENTS SPECIFICATION

3.1 INTRODUCTION

Industrialization has been beneficial for women. It increased female participation in labor outside the home. Subsequently, infant care has become a challenge to many families in their daily life. Mother is always worried about the well being of her baby while working.

In India both the parents need to work and look after their babies/infants, so more workload and stress is there on such families especially on female counterparts. If system is developed which continuously gives updates about their infants during illness or during normal routine then it will be of great help to such members as they can work in stress less environment giving more fruitful output. Also urgent situation condition can be quickly noticed and handled within less time.So there has to be a system which can monitor the activities of the babies and/or infants to measure the health parameters and give this information to their parents.

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Objectives:

(a) To study the infant health parameters.

(b) To study the working of pulse rate sensors.

(c) To study the interfacing of arduino hardware components.

(d) To study android GUI creation.

3.1.1 PROJECT SCOPE

This system can be used at home where in the parents can monitor or track their baby's health even when they are at work or outside their home.This project will also help to monitor the health of babies in the hospitals, which will help the doctors and ease their work.

3.1.2 USER CLASSES AND CHARACTERISTICS

This project is meant to offer a brief solution that is faster ,easier,concise and more convenient than manually monitoring baby to ensure its health.It will also help parents to focus on their work rather than always being worried about the child.Parents can rely on this system and can continue their daily routine without any burden.

The parents can use their mobiles to check their child's health and at the same time they can ensure that all the information that they obtain is correct.In case the data obtained by sensors placed on the baby's sock is found to be anomalous then the system will generate an alarm as well as notify the parents abut the situation.

Besides being useful at homes, the system can be useful at hospitals as the doctors and nurses can continuously get an update about the babies health and can thus take appropriate actions without any delay.

3.1.3 DESIGN AND IMPLEMENTATION CONSTRAINTS

The primary design constraint is hardware component used in our system. It is possible that the sensors may generate varied values or the hardware is not in proper contact with the baby's foot.As the main requirement for our system to give good performance is fast Internet, thus in the cases of slow connection the data transfer would slow down which may generate incorrect results that may result in improper actions to be taken.

3.1.4 ASSUMPTIONS AND DEPENDENCIES

This project will work on the minimum system specifications as follow:

- Linux operating system.
- Public Cloud Server.
- Android mobile as a hardware unit.
- Android mobile for installing the monitoring application.

Time Dependency:
Usability improvements and convenience enhancements that may be added after the application has been developed. Thus, the implementation of these features is entirely dependent upon the time spent designing and implementing the core features. The final decision on whether or not to implement these features will be made during the later stages of the design phase.

3.2 EXTERNAL INTERFACE REQUIREMENTS

The various hardware, software and communication requirements of our system can be determined as follows:

Types Of Interfaces	Components	Purpose
Hardware Sensors	Oxymetry Sensors, Pulse Sensors	To measure the infant's body parameters
Hardware Boards	Arduino Board, ADC	To provide connection between the system and parents
	Hardware Unit	To compare the obtained values with the actual values
	Android Mobiles	To get notifications
	Cloud Server	To forward the data from system to cloud and vice versa
Software	Linux	For interfacing sensors to system
	Application on parents mobile	For receiving updates
	Algorithm on the hardware unit	For data comparison.
Communication	Bluetooth	For transmitting data from sensors to hardware unit
	WiFi Module	To transmit data from hardware unit to cloud server.

Figure 3.1: Interfaces Required

3.3 NON FUNCTIONAL REQUIREMENTS

These requirements don't affect the system features but play an important role in deciding other factors that are important for a software application to be reliable.

3.3.1 PERFORMANCE REQUIREMENTS

In our project the main requirement is of Internet by using which the user can obtain the real time updates about the health of babies.Also, the sensors must be placed properly to obtain the accurate data.

3.3.2 SAFETY REQUIREMENTS

The application doesn't affect any other features of machine and since no hardware other than system is used there are no specific safety requirements for handling system.During parameter collection we have to just take care that system is capable to transmit the data without any loss.

3.3.3 SOFTWARE QUALITY ATTRIBUTES

The application software gives justice to important quality attributes such as:

- **Flexibility:**
  Various types of inputs accepted by the system.
- **Reliability:**
  The system will provide precise data and will also notify when found an abnormality in the health status.
- **Usability:**
  Provides simple user interface easily accessible by the concerned user.
- **Security:**
  Secure as the system asks for user's credentials to provide access to system.
- **Dependability:**
  The application on parents mobile is dependable as it will provide the data on database via server.

3.4 OTHER REQUIREMENTS

These are optional requirements which are not of that importance but if included gives an additive advantage to the application software usage.

3.4.1 DATABASE REQUIREMENTS

Serialized Objects / Serialization - Database in Java
In case the project needs database this is how it is handled in java.

A.First step is to use data structures like Vectors and Lists. These come under Java Collections API.

B. Secondly we declare our own classes using these data structures. E.g. a class Student to hold all the student information.Now these classes need to be precompiled and called within Java application as libraries.This is called as a Java Class Library

C. Now class objects cannot be saved to hard drive directly. We need to convert these objects to bytes so that they can be saved to hard drive. To do this we must use a concept called as Serialization. Basically it is a concept where in objects are converted to byte streams so that they can be saved to hard drive or sent via Internet and vice versa. The reverse process is called as deSerialization.

D. Finally to save these bytes to hard drive or to send them via network we need Java I/O.

3.4.2 CLOUD COMPUTING

In order to implement a cloud architecture or a Software As A Service (SaaS architecture) we need

A.WebService we need to implement a web service.

B.GlassFish Server to host web service

C.SOAP API to be able to call web service at client side we need to use SOAP API or even XML

3.5 ANALYSIS MODEL

3.5.1 DATA FLOW DIAGRAMS

Level-0

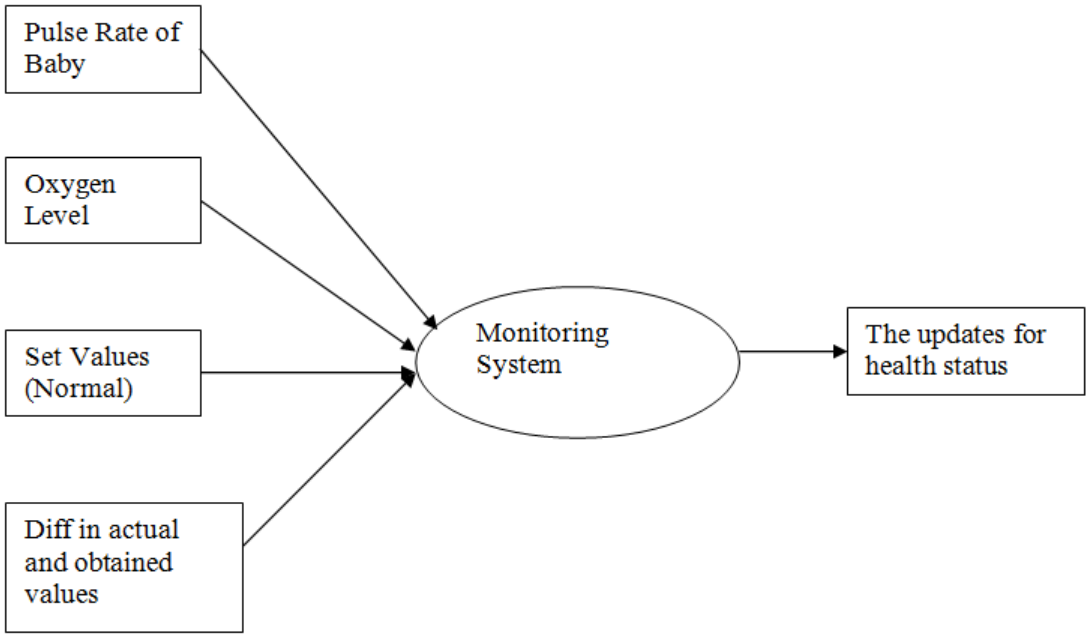

Figure 3.2: DFD Level 0

Description

In this level, we have just shown the basic design of our system where in the monitoring system is just accepting the values from the sensors and the expected values.The system then compares these values and generates the expected outcome.

Level-1

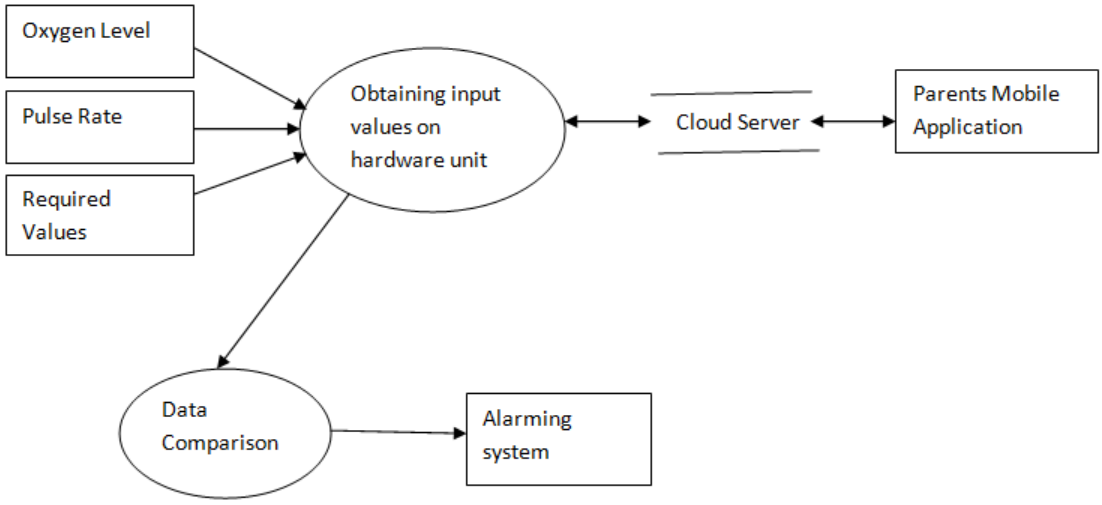

Figure 3.3: DFD Level 1

Description

In Level-1 DFD we have tried to explore our system by adding various processes to the main monitoring process. As per the design at level-1, our system will not only compare the values taht are being provided to it but it will also notify the parents about the various conditions such as if the parameters are normal then the data will simply be sent to cloud, butin case the data is abnormal then an alarm would be generated.

3.5.2 MATHEMATICAL MODEL

$$M = \{S, Q, ou, su, Fa, F\}$$

Here,
S :=System having different states
Q :=set of input states
ou:=set of output states
su:=Successful working of overall system
Fa:=Inefficient system working
F :=End

Model

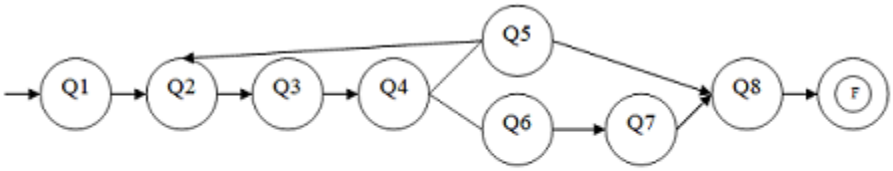

Figure 3.4: Mathematical Model

States:

Where,
Q1=Start the system
Q2=Read the input parameters such as oxygen level,pulse rate of the baby with the help of sensors.
Q3=Transfer the data to the notifier
Q4=If notifier blinks green then continue and go to state Q5 and continue else go to state Q6
Q5=The parameters are correct and there is no problem, continue to take input
Q6=An abnormal situation, notify the parents on their mobiles.
Q7=Parents receive a notification
Q8=Store the data on server.
F=End

3.6 SYSTEM IMPLEMENTATION PLAN

Table 3.1: System Implementation Plan Phase-I

SR. NO.	TASK NAME	DURATION	COMPLETION
1.	Project Topic Selection	15 days	✓
2.	Literature Survey	10 days	✓
3.	Study Of Existing System	5 days	✓
4.	Synopsis & Abstract Submission	15 days	✓
5.	SRS	15 days	✓
6.	Design Of System Architecture	5 days	✓
7.	Design Of UML Diagrams	5 days	✓
8.	Planning Of System Modules & Interface	8 days	✓

Table 3.2: System Implementation Plan Phase-II

SR. NO.	TASK NAME	DURATION	COMPLETION
9.	Implementation of hardware & Storage	10 Days	
10.	Implementation Of Android App	10 Days	
11.	Implementation Of Cloud Server functionality	10 Days	
12.	Interfacing of hardware components	10 Days	
13.	Output Display	8 Days	
14.	Testing Of Above Modules After Completion of Each Module	5 Days Per Module	
15.	Project Review	5 Days	

Chapter 4

SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE

Health monitoring systems have rapidly evolved during the past two decades and have the potential to change the way health care is currently delivered. As we are developing baby monitoring system, it mainly consists of following modules-

(a) Taking input from sensors.

(b) Transfer readings to hardware unit.

(c) Send data to cloud server using Wi-Fi or Internet.

(d) Forward the data to parents app using Internet from the cloud server.

First, our system will take two inputs from the sensors which are (I) pulse rate and (II) Oxygen level. Signal conditioner will be used for signal conditioning. Signal conditioning is the manipulation of a signal in a way that prepares it for the next stage of processing. The applications which involve environmental or structural measurement, such as temperature and vibration, from sensors, require signal conditioning before a data acquisition device can effectively and accurately measure the signal.

An ADC will provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number proportional to the magnitude of the voltage or current. Typically the digital output will be a two's complement binary number that is proportional to the input. Micro controllers will be used for automatically controlling products and devices. This micro controller chip will also consists of Bluetooth controller. Bluetooth is a wireless technology standard for exchanging data over short distances. Using this Bluetooth controller, the input data of the sensors can be easily transferred to the hardware unit.

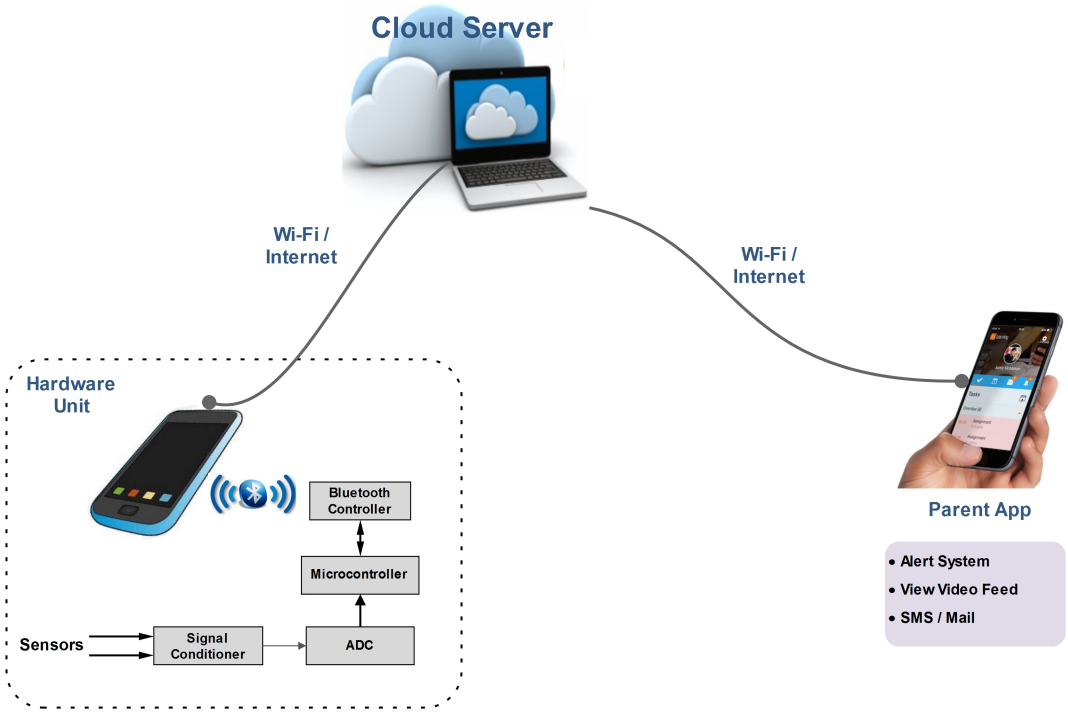

Figure 4.1: System Architecture

The hardware unit will perform various tasks. It will compare the input parameters with the threshold values and immediately forwards the data in case of anomaly. Hardware unit will forward the data to the cloud sever through the Internet which then forwards the parameters to the parents phone. So, this hardware unit will be connected to the micro controller using Bluetooth controller and will also be connected to Cloud Server through the Internet. Hardware unit must be constantly connected to the Internet in order to forward the data in real time and efficiently.

Cloud server will then forward this data to the parents phone by making use of Internet. The real time measurements of the sensors can be forwarded. The android app will notify parents about the childs health parameters. The alert system will be activated and will start alarming if there are troublesome readings. It will help parents to understand the situation and take immediate actions on the same. SMS will be sent to the parents phone in order to notify them about the situation.

The overall flow for the system is shown in *Figure 4.2* that is the flow graph for our system.

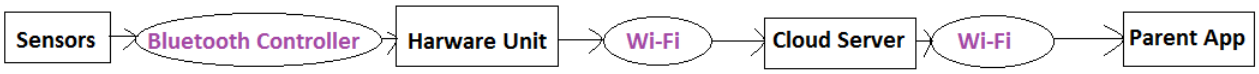

Figure 4.2: System Flow Graph

4.2 UML DIAGRAMS

Definition

The Unified Modelling Language (UML) is a general purpose,developmental, modelling language in the field of software engineering, that is intended to provide a standard way to visualize the design of a system. UML was originally motivated by the desire to standardize the disparate notational systems and approaches to software design.

Design

The Unified Modelling Language (UML) offers a way to visualize a system's architectural blueprints in a diagram including elements such as:

- Any activities.
- Individual components of the system: And how they can interact with other software components.
- How the system will run.
- How entities interact with others (components and interfaces)
- External user interface

Although originally intended solely for object oriented design documentation, the Unified Modelling Language (UML) has been extended to cover a larger set of design documentation.

UML System Model

- **Static (or structural) view:**
  Emphasizes the static structure of the system using objects, attributes, operations and relationships. The structural view includes class diagrams and composite structure diagrams.
- **Dynamic (or behavioural) view:**
  Emphasizes the dynamic behaviour of the system by showing collaborations among objects and changes to the internal states of objects. This view includes sequence diagrams, activity diagrams and state machine diagrams.

UML Models

USE CASE DIAGRAM

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors).

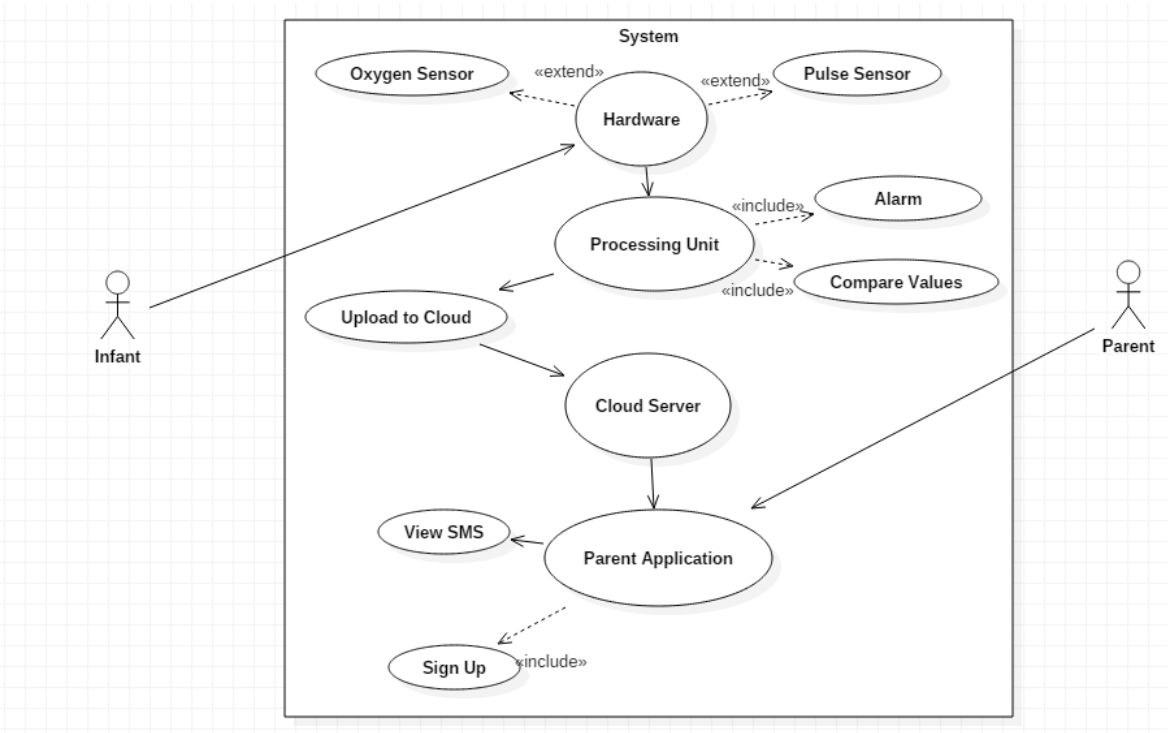

Figure 4.3: Use Case Diagram

Description

Title	Description
Use Case Name	Baby Monitoring System
Use Case Identifier	ID:1
Brief Description	Monitoring infants health by checking their pulse rate and oxygen level
Primary Actor	Infant, Parent
Secondary Actor	Device Application
Precondition	User must login and get connected with the server
Main Flow	**At System Side:** 1. The user must login to the system in order to get connected to the database. 2. The sensors placed into the socks, shall read the parameters like pulse rate and oxygen level of the baby and will transfer the data to the processing unit which will compare the values. 3. If the data is found to be abnormal then an alarm would be generated. **At Parents Side:** 1. The parents initially must login to their mobile application. 2. Parents will then receive the real time updates about the infants various health parameters.
Alternate Flow	None

Table 4.2.1:Use Case Diagram Description

SEQUENCE DIAGRAM

A Sequence diagram is an interaction diagram that shows how processes operate with one another and in what order. It shows object interactions arranged in time sequence.

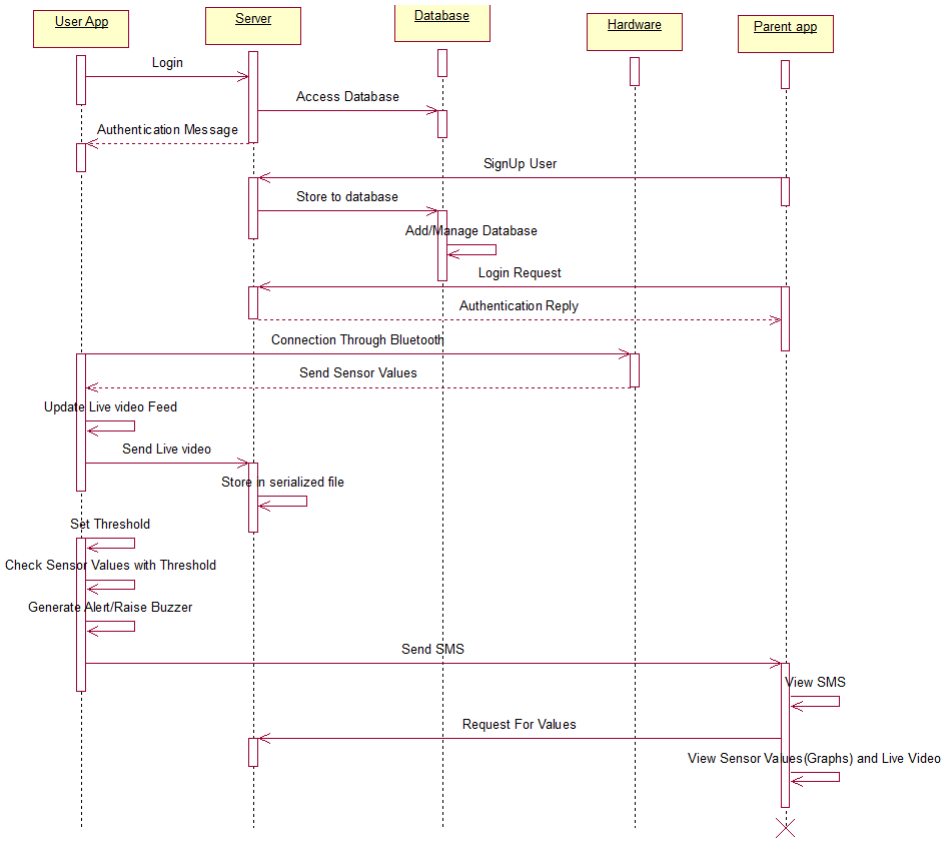

Figure 4.4: Sequence Diagram

Description

- Initially we need to log in to the server via User Application in order to access database.
- At parent's side, the parents need to log in too via the application on their phones so that they' will get connected to the system via Bluetooth.
- The connection will help parents to receive the regular updates of their child's health and also to view the live video to monitor their infants activities.

STATE CHART DIAGRAM

The name of the diagram itself determines that it represents different states of a component in a system. The states are specific to a component/object of a system.

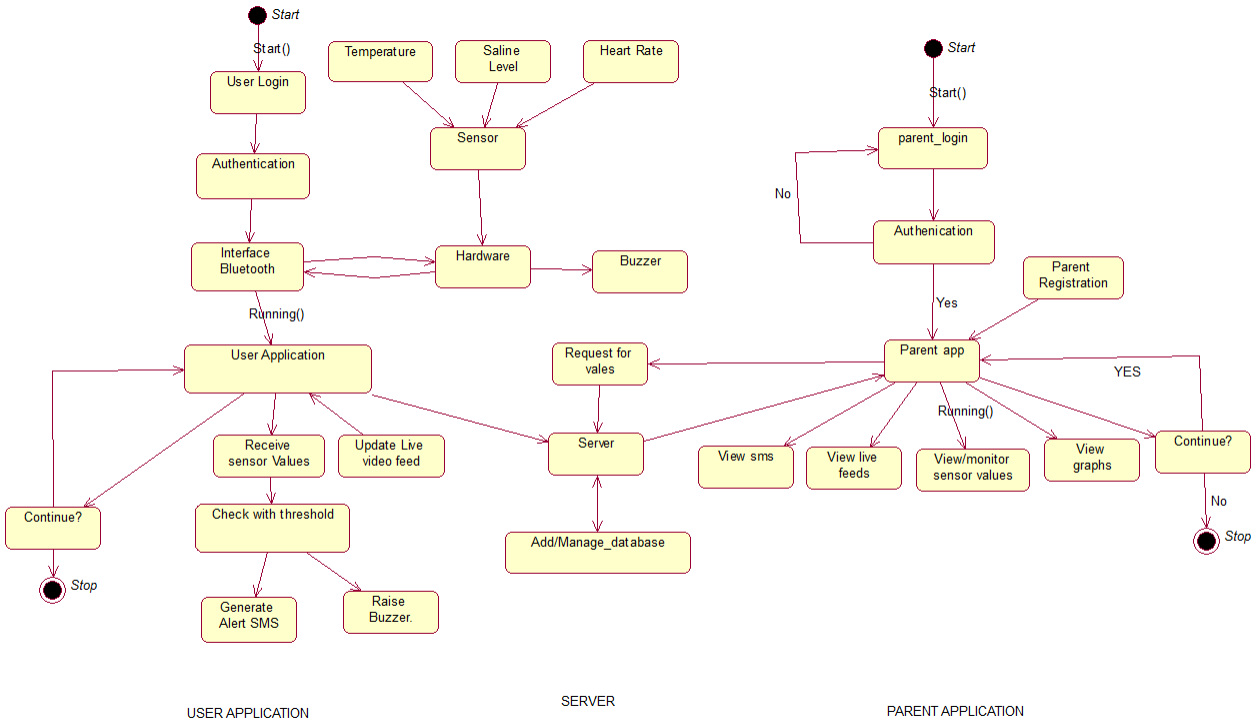

Figure 4.5: State Chart Diagram

Description

- The system will be initiated by user log in.
- Once log in is done,then the user application will begin to run.
- At parents side the parent will log in and begin to use the system.

Main states include of:

- **User application:**Used to process the data
- **2.Hardware:**To Obtain the values
- **3.Server:**To store and transfer the data
- **4.Parent application:**To obtain real time updates

ACTIVITY DIAGRAM

Activity diagram is basically a flow chart to represent the flow form one activity to another activity. The activity can be described as an operation of the system.

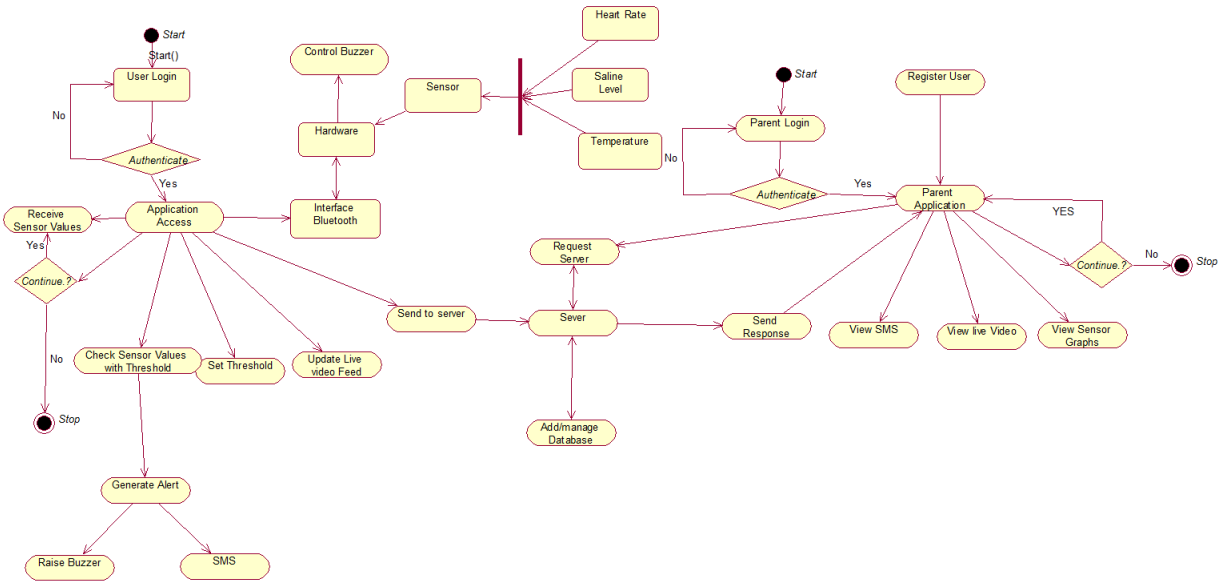

Figure 4.6: Activity Diagram

Description

- In activity diagram, we have tried to describe the entire project work through various activities and the resulting flow of data.
- The significance of activity diagram in our project is that we can use it to describe how the system forwards the data and information by handling various types and patterns of data.

CLASS DIAGRAM

In software engineering, a class diagram in the Unified Modelling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

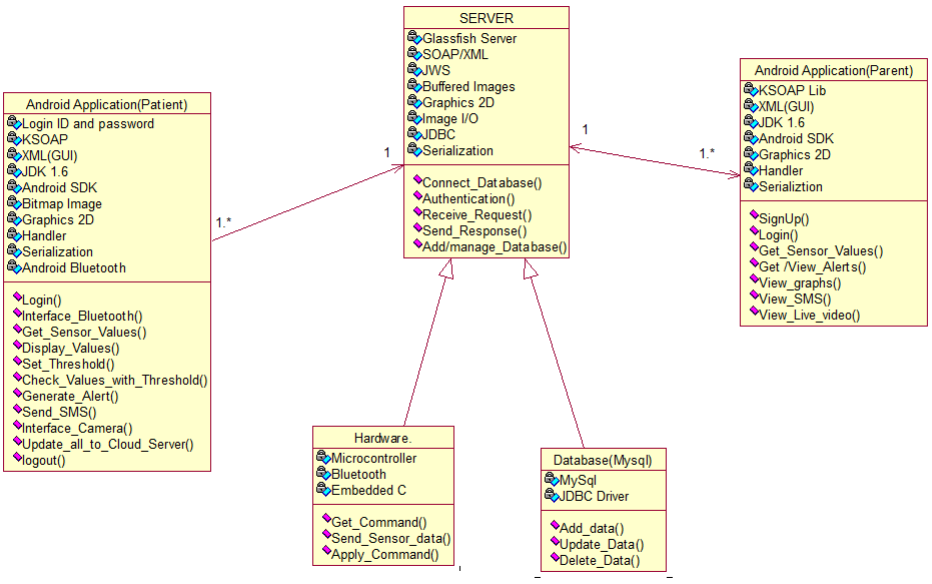

Figure 4.7: Class Diagram

Description

- **Android Application(Infant):** Includes of all the features that the system is providing by using various techniques.
- **Server:** Describes how to connect the server to the application thus bridging out the space and by using various hardware and software interfaces.
- **Android Application(Parents):** Determines the actions that the parent must take in order to use the system.

Chapter 5

TECHNICAL SPECIFICATION

5.1 ADVANTAGES

- User Friendly.
- Easy to monitor health of infant.
- Convenient to handle.
- Portable.

5.2 DISADVANTAGES

- May not be accurate.
- May not work without the Internet.

5.3 APPLICATIONS

- Infant care has become a challenge to many families in their daily life. Parents are always worries about the well being of their baby.An innovative approach for infant monitoring system using pulse rate and oxygen level, which gives a reliable and efficient baby monitoring system that can play a vital role in providing better infant care. This system monitor vital parameters such as body temperature, pulse rate and sends updates to their parent.

- In the hospitals 40 percent of all newborn babies require care in a ICU.The size of patients is very variable, as well as their length of stay in the ICU. Most babies admitted into the ICU are premature,have low birth weight,or have a medical condition that requires special care.So here we can use these proposed system that monitors the health parameters of babies continuously that means it provides the special care.

- The sudden death of an infant during sleep that is not predicted by the medical history and remains unexplained even after thorough forensic autopsy and detailed death investigation.In these proposed system, we continuously get the readings of babys pulse rate and any abnormal data is observed then immediately sends alerts to their parents,give emergency call to hospitals hence here we predict the death of infant.

- By using these proposed system we can do infant monitoring as-well-as patient monitoring in various environments including hospitals and nursing homes. Due to wireless technology it provides better treatments to patients though they are physically not present in hospital.This system is more useful for elderly people as they are more prone to chronic diseases and need continuous health monitoring.

- The collection, analysis and dissemination of health data and information of infants will design to support in decision making for further care taken in the hospitals.By using these health parameters doctors will take decision immediately.

Chapter 6

RESULTS

6.1 EXPECTED OUTCOMES

From the proposed system, we can expect an efficient baby monitoring system which can efficiently obtain the inputs from the sensors and provide real-time updates to the parents.

These updates will be helpful for the parents to take appropriate actions on the infant in any detected medical conditions. This system can also be used by hospitals to keep track of the patients automatically rather than manually monitoring them.

Chapter 7

CONCLUSION

Existing systems does not provide real time updates on parents phone, rather it simply generates an alarm. Not many monitoring systems are available that can be used with ease at home. It is also necessary for parents to keep track of baby when they are not at home.

Hence, in our proposed system, we tried to overcome the limitations of earlier systems by providing the continuous data of infants health. This data can be used not only to track infant's health at home but also useful to continuously monitor babies at hospitals especially where manual monitoring is not always possible.

Chapter 8

FUTURE SCOPE

The development of our project till now is just bound to measure the pulse rate and oxygen level of the baby, and provide the updated parameters to the parents.The further project development will be focusing on reducing the size of the monitoring system, improving the sensors accuracy and developing the system such that it can measure other parameters of the babies such as temperature, wrong way of sleeping that might chock their breath and other relevant things.

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Appendix A

ASSIGNMENTS

Lab Assignment 01

Aim

Refer Chapter 7 of first reference to develop the problem under consideration and justify feasibility using concepts of knowledge canvas and IDEA Matrix.

Project

An innovative approach for infant monitoring system using pulse rate and oxygen level.

Purpose	**Goals**	**Users**	**Actions**	**Deliverables**
The existing system does not provide any information of the health status of baby to its parents on their phones .Our system is designed to solve this problem by generating the real time updates about health status of baby to its parents.	1. To provide the health status of baby to its parents 2. To make it easy to track the real-time information	1. Doctors 2.Parents	1. Place the sock on infants foot 2. Open the application 3.Monitor baby's health through real time parameters.	1. SRS 2.Project Report 3.Design Documents
Risks	**Milestones**	**Constraints**	**Scope**	**Results**
1. Sensors may give inaccurate data 2.Problem can occur if the sock is not properly placed on the foot	1.To reduce the bulkiness of the system 2.To make the system available at lower cost 3.Increase the number of parameters and types of data that the sensors can read	1.Design constraints: • Hardware is not available easily • the sensors should be placed properly 2.Contionuous network is required for data collection.	1.Our system is useful for hospitals where the doctors can use it to track baby's health when manual monitoring is not possible. 2.Also, it is useful at homes where both parents go to work	A smart monitoring system that continuously monitor and provide real time updates even at home

Figure A.1: IDEA MATRIX

Lab Assignment 02

Aim

Project problem statement feasibility assessment using NP-Hard, NP-Complete or satisfy ability issues using modern algebra and/or relevant mathematical models.

Feasibility Theory

The feasibility of the project can be defined as the measure of our project whether it is viable or not.It includes various different types of feasibility as follows:

- **Performance:**
  In this we check whether the proposed system is capable of performing all the functional requirements as mentioned in system features in SRS.If our system is displaying the functional requirements appropriately then it's performance is feasible.Here we also check the accuracy and efficiency of the system based on their algorithms.

- **Technical:**
  In this we check whether the technical specification provided that is hardware and software requirements are minimum requirements for our application software to run successfully without any error regarding the system configuration.Also the storage requirements is quite enough and concurrency takes place effectively.

- **Economical:**
  In this we check the cost per line of code also the cost for storage of data and cost related to the run time of the system.Apart from this since no extra hardware is needed apart from minimum system configuration for the computers on network.

Feasibility on basis of Class of Problem

Complexity classes are one way to talk about how difficult or easy a problem is. Complexity theory gets very technical but the basics are actually extraordinarily intuitive, and it's possible to understand the P versus NP issue with very little math background.

If there is a fast solution to the search version of a problem then the problem is said to be Polynomial time, or P for short. If there is a fast solution to the verification version of a problem then the problem is said to be Non deterministic Polynomial time, or NP for short. The question of "P=NP" is then the question of whether these sets are identical.

Some problems can be translated into one another in such a way that a fast solution to one problem would automatically give us a fast solution to the other. There are some problems that every single problem in NP can be translated into, and a fast solution to such a problem would automatically give us a fast solution to every problem in NP. This group of problems are known as NP Hard.Some problems in NP Hard are actually not themselves in NP the group of problems that are in both NP and NP Hard is called NP Complete.

Classes of problems

- **NP**
  A lot of programs that don't (necessarily) run in polynomial time on a regular computer, but do run in polynomial time on a non deterministic Turing machine. These programs solve problems in NP, which stands for non deterministic polynomial time.An equivalent way to define NP is by pointing to the problems that can be verified in polynomial time.

- **NP Hard**
  If a problem is NP hard, this means I can reduce any problem in NP to that problem. This means if I can solve that problem, I can easily solve any problem in NP. If we could solve an NP hard problem in polynomial time, this would prove P = NP.

- **NP Complete**
  A problem is NP complete if the problem is both NP hard, and in NP.

Since our system satisfies both problems of measuring the input parameters accurately as well as taking proper actions on the obtained input parameters.

Our system can handle large amounts of data and provide a fast and real-time transferring of data, thus it is said to be P type problem capable to solve a part in polynomial time also as the system requires time to take an appropriate action and decision making, it is NP complete problem.

Relation Between Classes of Problems

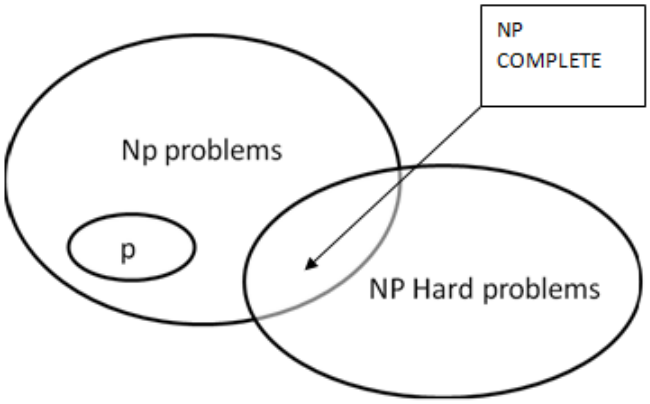

Figure A.2: Relation between Classes of Problems

Mathematical Model

$$M = \{S, Q, ou, su, Fa, F\}$$

Here,
S :=System having different states
Q :=set of input states
ou:=set of output states
su:=Successful working of overall system
Fa:=Inefficient system working
F :=End

Model

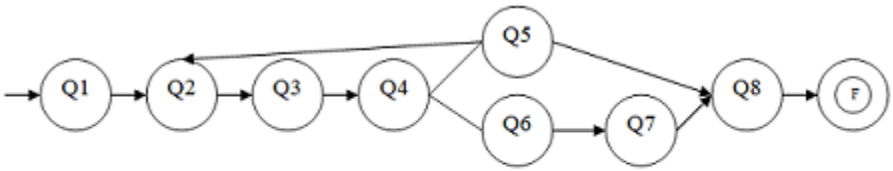

Figure A.3: Mathematical Model

States:

Where,
Q1=Start the system
Q2=Read the input parameters such as oxygen level,pulse rate of the baby with the help of sensors.
Q3=Transfer the data to the notifier
Q4=If notifier blinks green then continue and go to state Q5 and continue else go to state Q6
Q5=The parameters are correct and there is no problem, continue to take input
Q6=An abnormal situation, notify the parents on their mobiles.
Q7=Parents receive a notification
Q8=Store the data on server.
F=End

Lab Assignment 03

Aim

Use of divide and conquer strategies to exploit distributed/parallel/concurrent processing of the above to identify objects, morphisms, overloading in functions (if any), and functional relations and any other dependencies (as per requirements).

Concept

A divide and conquer algorithm works by recursively breaking down a problem into two or more sub-problems of the same (or related) type (divide), until these become simple enough to be solved directly (conquer). So have divided our problem based on algorithm used and those are:

- Obtaining parameters.
- A notifier in order to determine the abnormal health condition of babies.
- Transferring data to server.
- Transferring the obtained updated data on parent's phone.

Divide and conquer (D&C) is an algorithm design paradigm based on multi-branched recursion. So we have to recursively divide our problem into sub-problems of the same (or related) type (divide), until these sub-problem become simple enough to be solved directly (conquer). The solutions to the sub-problems are then combined to give a solution to the original problem.

The divide-and-conquer strategy solves a problem by:

1. Breaking it into sub problems that are themselves smaller instances of the same type of problem

2. Recursively solving these sub problems

3. Appropriately combining their answers

Using this strategy of divide and conquer, our system works as follows:

The entire system is divided into various functions where the sensors at first gather the health parameters of babies.This collected data is then compared with the required values and the difference between these actual and obtained parameters determine the health status of babies.In the third phase this data is transmitted to the server and lastly the data is provided on the mobiles of the parents to notify them about their baby's health.

The system consists of the following components for performing the required functions:

- Pulse and Oximetry Sensors for data gathering
- A device to notify the abnormal situation
- Server with actual required values stored on it
- an application on mobiles for providing updates

Level-0

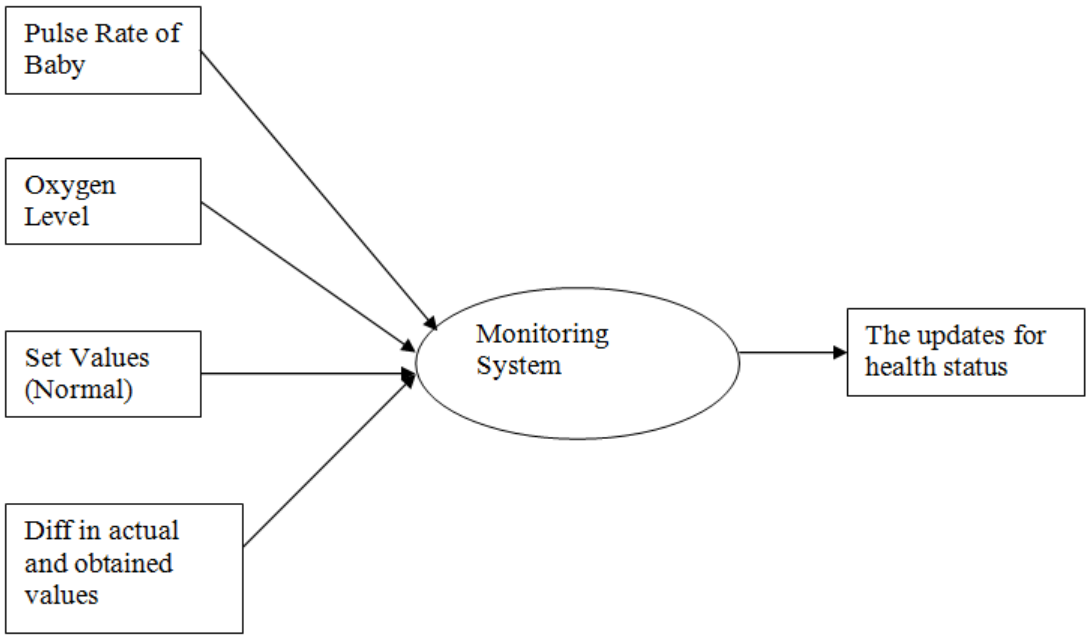

Figure A.4: DFD Level 0

Description

In this level, we have just shown the basic design of our system wherein the monitoring system is just accepting the values from the sensors and the expected values.The system then compares these values and generates the expected outcome.

Level-1

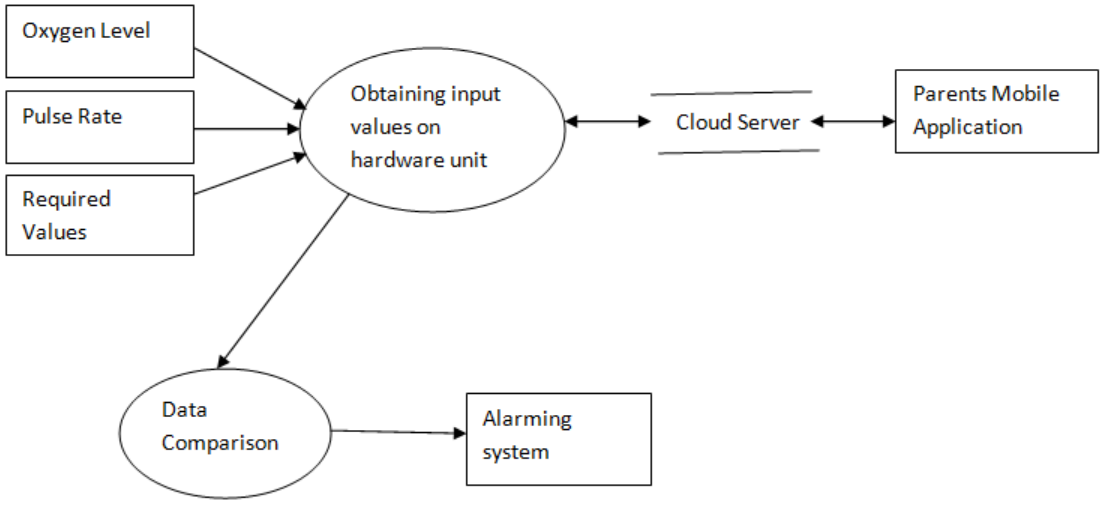

Figure A.5: DFD Level 1

Description

In Level-1 DFD we have tried to explore our system by adding various processes to the main monitoring process. As per the design at level-1, our system will not only compare the values taht are being provided to it but it will also notify the parents about the various conditions such as if the parameters are normal then the data will simply be sent to cloud, butin case the data is abnormal then an alarm would be generated.

Lab Assignment 04

Aim

Use of above to draw functional dependency graphs and relevant Software modelling methods, techniques including UML diagrams or other necessities using appropriate tools.

USE CASE DIAGRAM

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors).

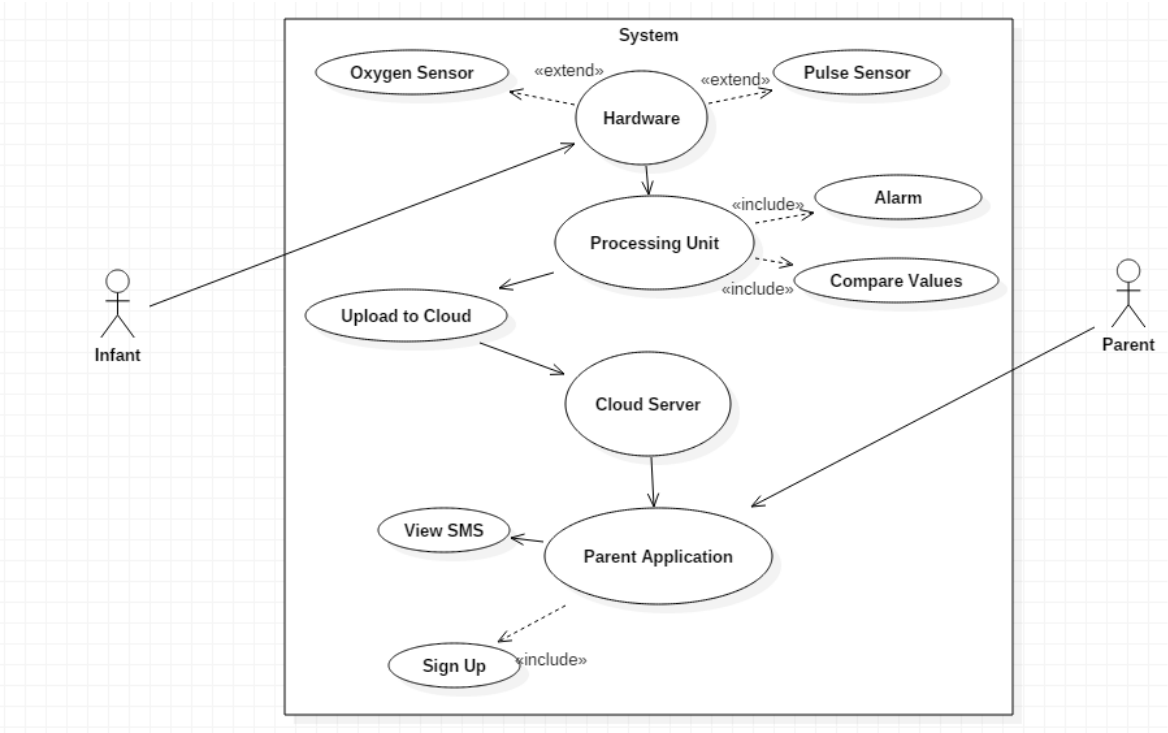

Figure A.6: Use Case Diagram

Description

Title	Description
Use Case Name	Baby Monitoring System
Use Case Identifier	ID:1
Brief Description	Monitoring infants health by checking their pulse rate and oxygen level
Primary Actor	Infant, Parent
Secondary Actor	Device Application
Precondition	User must login and get connected with the server
Main Flow	**At System Side:** 1. The user must login to the system in order to get connected to the database. 2. The sensors placed into the socks, shall read the parameters like pulse rate and oxygen level of the baby and will transfer the data to the processing unit which will compare the values. 3. If the data is found to be abnormal then an alarm would be generated. **At Parents Side:** 1. The parents initially must login to their mobile application. 2. Parents will then receive the real time updates about the infants various health parameters.
Alternate Flow	None

Table 4.2.1:Use Case Diagram Description

SEQUENCE DIAGRAM

A Sequence diagram is an interaction diagram that shows how processes operate with one another and in what order. It shows object interactions arranged in time sequence.

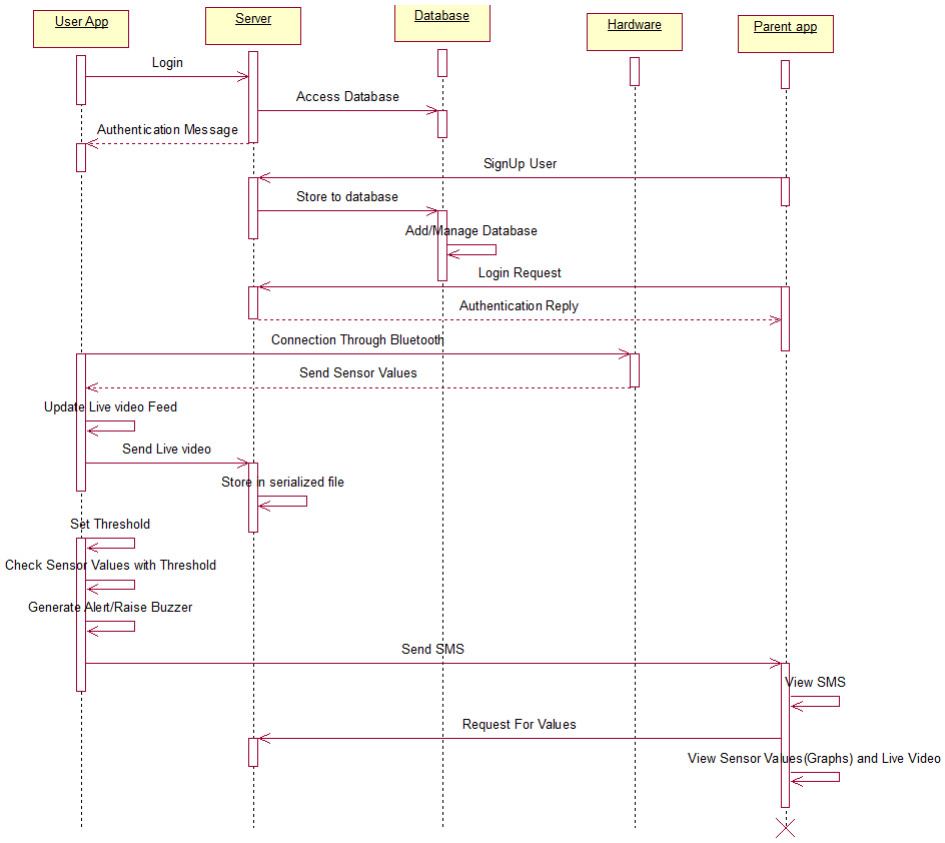

Figure A.7: Sequence Diagram

Description

- Initially we need to log in to the server via User Application in order to access database.
- At parent's side, the parents need to log in too via the application on their phones so that they' will get connected to the system via Bluetooth.
- The connection will help parents to receive the regular updates of their child's health and also to view the live video to monitor their infants activities.

STATE CHART DIAGRAM

The name of the diagram itself determines that it represents different states of a component in a system. The states are specific to a component/object of a system.

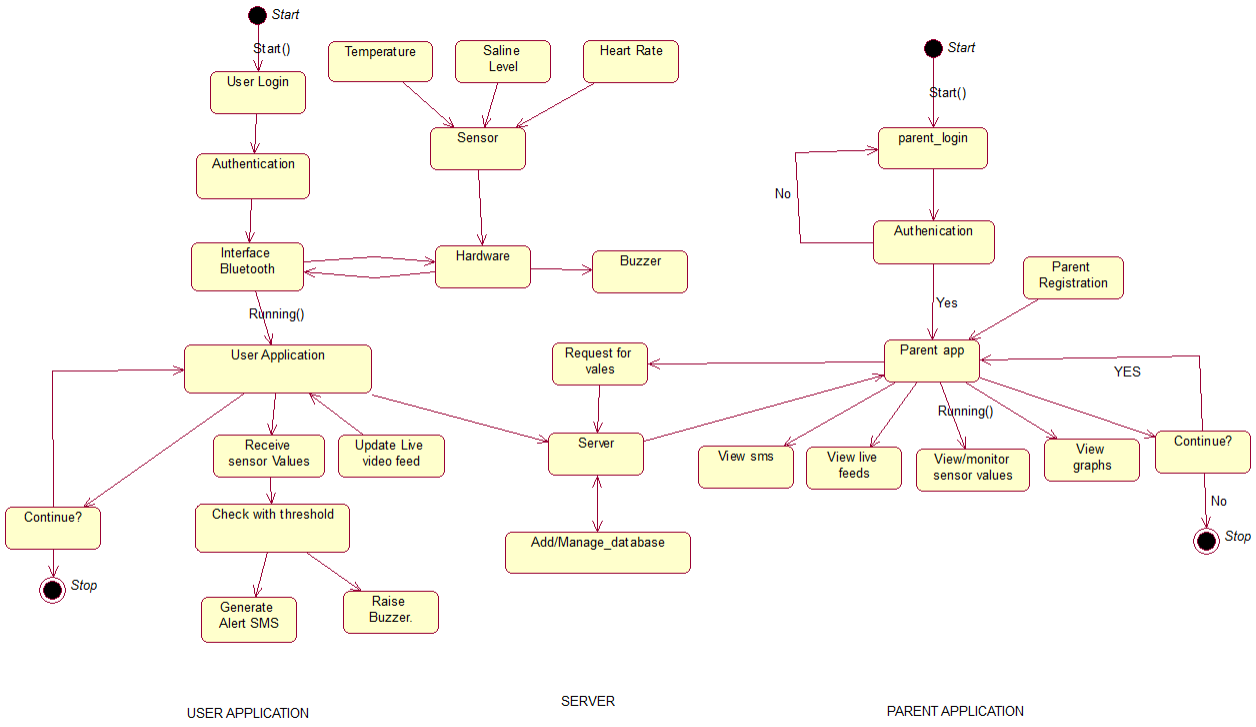

Figure A.8: State Chart Diagram

Description

- The system will be initiated by user log in.
- Once log in is done,then the user application will begin to run.
- At parents side the parent will log in and begin to use the system.

Main states include of:

- **User application:**Used to process the data
- **2.Hardware:**To Obtain the values
- **3.Server:**To store and transfer the data
- **4.Parent application:**To obtain real time updates

ACTIVITY DIAGRAM

Activity diagram is basically a flow chart to represent the flow form one activity to another activity. The activity can be described as an operation of the system.

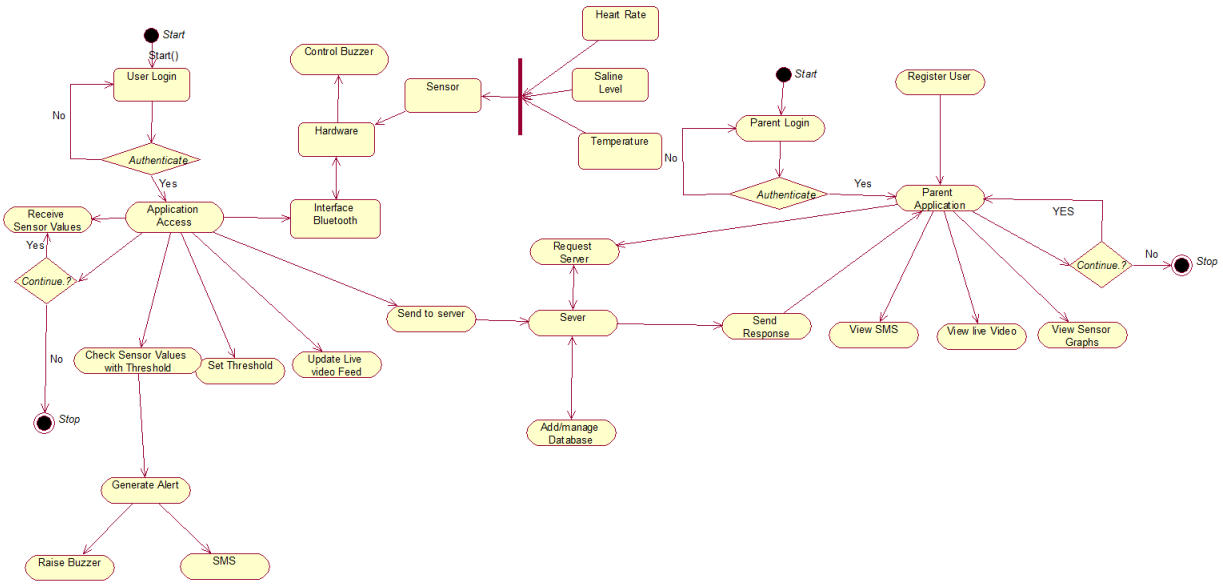

Figure A.9: Activity Diagram

Description

- In activity diagram, we have tried to describe the entire project work through various activities and the resulting flow of data.
- The significance of activity diagram in our project is that we can use it to describe how the system forwards the data and information by handling various types and patterns of data.

CLASS DIAGRAM

In software engineering, a class diagram in the Unified Modelling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

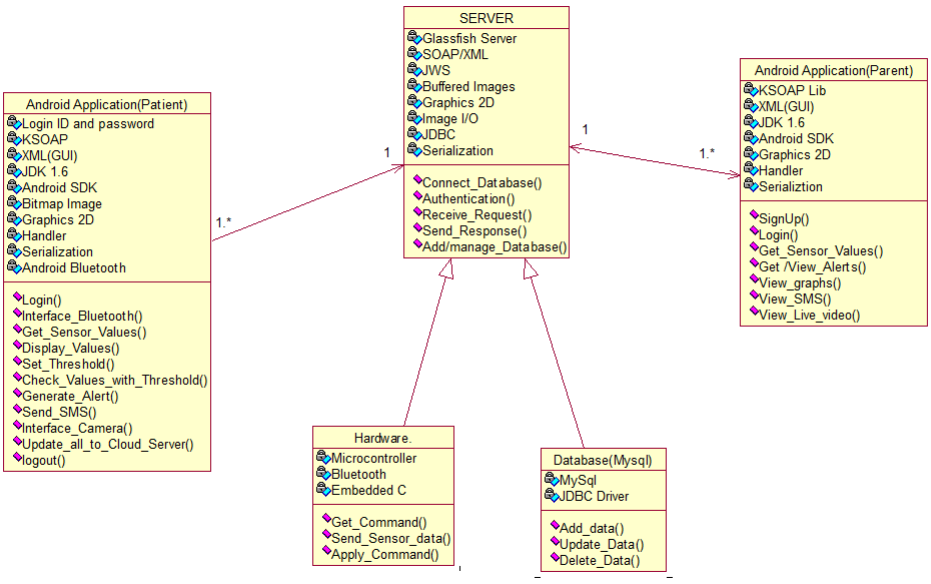

Figure A.10: Class Diagram

Description

- **Android Application(Infant):** Includes of all the features that the system is providing by using various techniques.
- **Server:** Describes how to connect the server to the application thus bridging out the space and by using various hardware and software interfaces.
- **Android Application(Parents):** Determines the actions that the parent must take in order to use the system.

Lab Assignment 05

Aim

Testing of project problem statement using generated test data (using mathematical models, GUI, Function testing principles, if any) selection and appropriate use of testing tools, testing of UML diagram's reliability.

Testing

Testing is the process of evaluating a system or its component(s) with the intent to find whether it satisfies the specified requirements or not.Testing is executing a system in order to identify any gaps, errors, or missing requirements in contrary to the actual requirements.A software bug is an error, flaw, failure or fault in a computer program or system that causes it to produce an incorrect or unexpected result, or to behave in unintended ways. Most bugs arise from mistakes and errors made in either a program's source code or its design, or in components and operating systems used by such programs. A few are caused by compilers producing incorrect code.

The job of testing is an iterative process as when one bug is fixed, it can illuminate other, deeper bugs, or can even create new ones.Software testing can provide objective, independent information about the quality of software and risk of its failure to users and/or sponsors.Software testing can be conducted as soon as executable software (even if partially complete) exists. The overall approach to software development often determines when and how testing is conducted.

Testing types

This section describes the types of testing performed on our project.The various testing types are as follows:

1.Adhoc Testing

This type of software testing is very informal and unstructured and can be performed by any stakeholder with no reference to any test case or test design documents. The person performing Adhoc testing has a good understanding of the domain and workflows of the application to try to find defects and break the software. Ad-hoc testing is intended to find defects that were not found by existing test cases.

In our system, we have done adhoc testing to check the following

- To check the work flow of the system
- To determine the correctness of the system components

2.Black Box Testing

Black Box Testing, also known as Behavioral Testing, is a software testing method in which the internal structure/ design/ implementation of the item being tested is not known to the tester. These tests can be functional or non-functional, though usually functional.This method is named so because the software program, in the eyes of the tester, is like a black box; inside which one cannot see. This method attempts to find errors in the following categories:

- Incorrect or missing functions
- Interface errors
- Errors in data structures or external database access
- Behavior or performance errors
- Initialization and termination errors

Here, in our system we have used black box testing to check:
1.The boundary conditions.
2.The database errors
3.Interfacing problems of the system and the users
4.The error free parameter checking

3.White Box Testing

White Box Testing is a software testing method in which the internal structure/ design/ implementation of the item being tested is known to the tester. The tester chooses inputs to exercise paths through the code and determines the appropriate outputs. Programming know-how and the implementation knowledge is essential. White box testing is testing beyond the user interface and into the nitty-gritty of a system.

The white box testing plays an important role in our project testing phase as it is important for determining whether the parameters obtained trough sensors when matched with the one in the database, generates the correct results and accurate information or not.

4.Unit Testing

A unit is the smallest testable part of software. It usually has one or a few inputs and usually a single output. In procedural programming a unit may be an individual program, function, procedure, etc. In object-oriented programming, the smallest unit is a method, which may belong to a base/ super class, abstract class or derived/ child class. The goal of unit testing is to isolate each part of the program and show that

the individual parts are correct.A unit test provides a strict, written contract that the piece of code must satisfy. As a result, it affords several benefits.

Unit testing finds problems early in the development cycle. This includes both bugs in the programmer's implementation and flaws or missing parts of the specification for the unit. The process of writing a thorough set of tests forces the author to think through inputs, outputs, and error conditions, and thus more crisply define the unit's desired behavior.

5.Integration Testing

Once all the individual units are created and tested, we start combining those Unit Tested modules and start doing the integrated testing. So the meaning of Integration testing is quite straight forward- Integrate/combine the unit tested module one by one and test the behavior as a combined unit. The main function or goal of Integration testing is to test the interfaces between the units/modules.The individual modules are first tested in isolation. Once the modules are unit tested, they are integrated one by one, till all the modules are integrated, to check the combinational behavior, and validate whether the requirements are implemented correctly or not.

6.System Testing

System Testing is a level of the software testing where a complete and integrated software is tested.The purpose of this test is to evaluate the systems compliance with the specified requirements.In System testing, the functionalities of the system are tested from an end-to-end perspective.

7.GUI Testing

GUI testing is the process of ensuring proper functionality of the graphical user interface (GUI) for a given application and making sure it conforms to its written specifications.In addition to functionality, GUI testing evaluates design elements such as layout, colors, fonts, font sizes, labels, text boxes, text formatting, captions, buttons, lists, icons, links and content. GUI testing processes can be either manual or automatic, and are often performed by third -party companies, rather than developers or end users.

In our monitoring system GUI Testing plays an important role for testing the User Interface of the Mobiles used for providing notifications to the parents about their baby's health.

Predicted Test Cases:

Test Cases	Function Tested	Precondition	Input Provided	Expected Outcome
Obtaining Parameters	Are parameters properly sensed by sensors?	Sensors are in contact with baby's body	Sensed data	Checking for parameters correctness
Testing data against the one in database	Is Algorithm for comparison working correctly?	Database must consist all the required parameters pre-stored	Parameters	Alert system must notify whether the comparison outcome is normal or not
Data Transferring	Is data getting properly transferred on parent's phone?	The parents must login and check the received messages on the application	Health Status Of Baby	Correct status must be provided

Figure A.11: Test Cases