Program: ESE 4009_1

INSTRUCTOR: Prof. Mike Aleshams

Group 6

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Project Proposal

Project Title:

IoT based Cradle system using SIDS monitor

Description of the latest similar system:

There are no similar products that function like ours in the current market. Although there are some products that measure an infant's oxygen and heart rate of a baby, there are other products that just function as a surveillance system.

Product name: 1) Owlet smart sock baby monitor

Product Description:

The Smart Sock is the first baby monitor to track your baby's oxygen level and heart rate—the best indication of baby's health—while they sleep. If your baby's readings leave preset "safe" zones, you'll receive a notification that lets you know your baby really needs you. Now you can feel more confidence, more freedom, and more peace of mind knowing that Owlet is here to help you keep your baby safe.

Product Image:

Parcel Dimensions	19.81 x 14.22 x 8.64 cm; 431 Grams
Batteries	1 Lithium ion batteries required. (included)

Item model number	BM06NNBBYG
Safety warning	Warning Strangulation Hazard: Children have strangled in cords. Keep this cord and the base station out of the reach of children (more than 3 feet (0.9m) away from the crib). Do not remove this tag. The Owlet Smart Sock is meant for healthy babies up to 18 months of age and the notification thresholds on Owlet Smart Sock are not as stringent as a medical monitor. The Smart Sock is an information-gathering product intended to assist in tracking the well-being of healthy babies from 5 to 30 pounds. It is not a medical monitor or other medical device and is not intended to diagnose, cure, treat, alleviate or prevent any disease or health condition or investigate, replace or modify anatomy or any physiological process. You should always follow pediatrician-recommended safe sleep practices when using the Smart Sock
Target gender	Unisex
Compatible products	Tablets, Smartphones : smartphones|iphone 5|samsung galaxy s9 plus|samsung galaxy s4|iphone 7|android phones
Batteries required	Yes
Battery type	Lithium-Ion
Item Weight	431 g

Limitations of the 1) Owlet smart sock baby monitor

One of the major limitations of this product is that it can damage the skin of a baby as illustrated in the image below. Also this product lacks many features like surveillance system, playing melodious sounds when baby cries, automatic swing for cradle and notification to guardians through sms.

Second limitation of this product is false alerts. Sometimes the system gives false alerts to parents and it creates anxiety unnecessarily.

It was found by Rebecca Edwards (Security Expert, Safety & Tech Reporter) that it creates false alarms and increases tension among parents and sometimes it fails to register problems also which is the main drawback of this product.

Product name: 2)Nanit Pro Camera

Product description:-

Nanit pro camera is the baby monitor that keeps you in the loop with your baby's overall development, including sleep, height, and breathing motion, while saving every precious milestone. It has temperature as well as humidity sensor, sleep tracking, HD video and two way audio system.

Product image:-

Limitations of 2)Nanit Pro Camera

This product requires the baby to wear a belt around the body all the time to track heart rate. Also, it lacks other features like automatic swing control, melodious music and notification through sms whenever the internet is not available. Also the users have experienced trouble in connecting the system with the internet and sometimes the sleep tracking feature gives false readings.

Initial Solution (in one or more pages)

(Block Diagram, Features, Hardware and Software Requirement, References):

Block Diagram:-
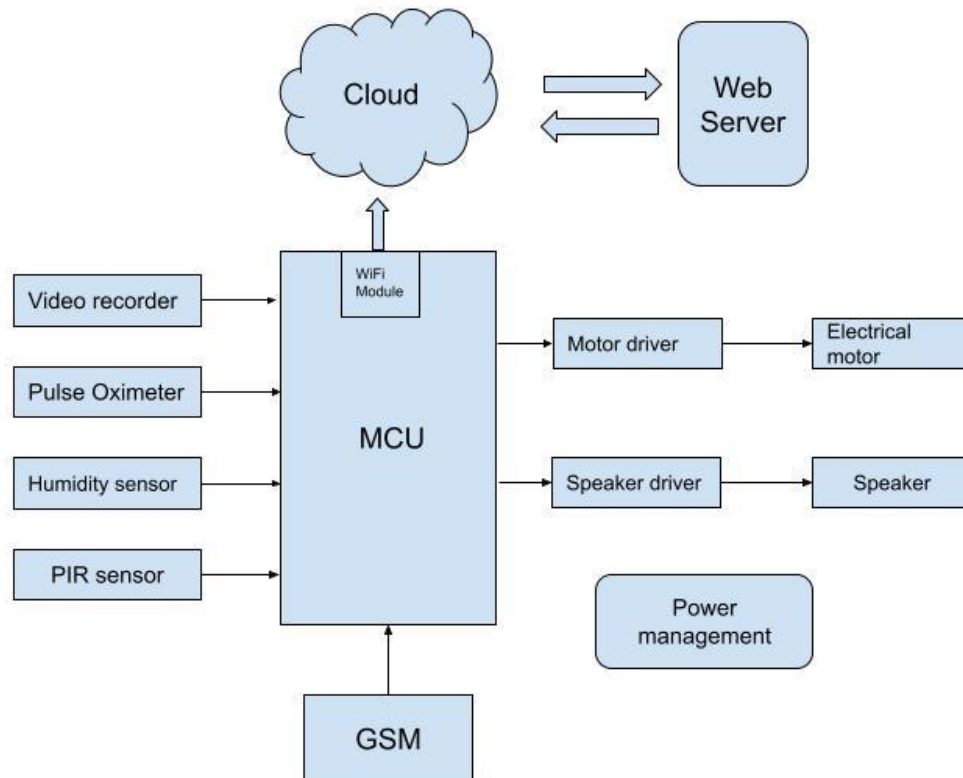
Features of our project:-

- ● SIDS monitor (sudden infant death syndrome)
- ● Cry detection
- ● Wetness detection
- ● Video Monitoring
- ● Swing control
- ● Provides alert in an emergency case
- ● Playing melodious music or sounds

Hardware requirement:-

- Microprocessor - RASPBERRY PI 3 MOD B+ BCM2837B0
- PIR sensor - HC-SR501
- USB camera and microphone - Logitech C920
- Speaker - USB mini speaker from Adafruit
- Humidity sensor - DHT11, DHT22 or AM2302.
- Electric motor - Servo Motor
- Motor Driver - L298N
- Pulse Oximeter - MAX30102
- GSM/GPRS Module - SIM868

Software requirement:-

- Raspberry Pi OS (Raspbian)
- C language, C++ or Python
- Kicad
- PCB Wizard
- Microsoft Azure

Alternate solution:

Hardware component:

BeagleBone Black Rev - C:- The BeagleBone Black is a low-cost credit-card-sized development platform with good support from a fast growing community. It comes with an onboard micro HDMI port, 512MB of DDR3L DRAM, 4GB onboard flash memory, an AM3358 (ARM® Cortex™-A8) processor at 1GHz, and making JTAG optional with a user-supplied header. Ultimately, the BeagleBone Black is still perfect for physical computing and smaller embedded applications.

Why do we choose beaglebone black?

The main reason that we choose BeagleBone Black is because it is capable of not just interfacing to all of the motor drivers, location or pressure sensors and 2D or 3D cameras, but also running OpenCV, OpenNI and other image collection and analysis software to recognize the objects around your robot and the gestures you might make to control it. Here we have used Beaglebone Black for processing.

BeagleBone Black block diagram:-
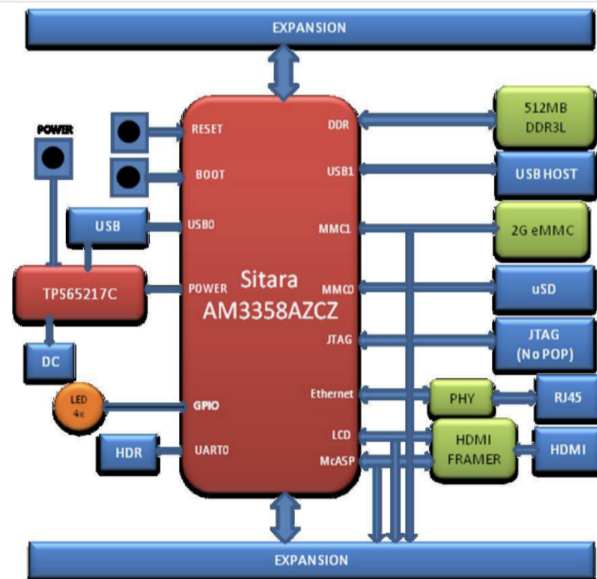
REF: BBONEBLK_SRM

Servo Motor vs DC Motor:

Difference Between Servo Motor and DC Motor in the tabulated form is given below.

BASIC	SERVO MOTOR	DC MOTOR
Wire system	The Servo motor is a three wire system known as power, ground and control.	DC motor is two wire system known as power and ground
Assembly	It has an assembly of four things: DC motor, gearing set, control circuit and a position sensor.	A DC motor is an individual machine with no assembly.

Rotation	Servo motor does not rotate freely and continuously like a DC motor. Its rotation is limited to 180^0	Movement of DC motor is continuous
Examples	They are used in robotic arms, legs or rudder control.	DC motors are used in car wheels, fans etc.

The Servo Motor is basically a DC motor which does not run continuously for a longer period of time. It has a unique arrangement which allows the motor to rotate at a specific angle with greater accuracy and precision. This machine is controlled by a feedback system.

Hence, a servo motor will be more appropriate to use for controlling the swing of a cradle.

Software component:

Programming language:

We have two options for programming, c and python. C is a general-purpose, procedural computer programming language.Python is an interpreted, high-level, general-purpose programming language.Compiled programs execute faster as compared to interpreted programs.Interpreted programs execute slower as compared to compiled programs.The syntax of a C program is harder than Python.Syntax of Python programs is easy to learn, write and read.

Main difference is that, we have to use c language to achieve real time features, we cannot achieve real time in python. Hence, we will use c in our project for achieving real time processes.

Google cloud:

- simpler and more understandable and low cost than other cloud services.
- It provides cloud SDK
- IT is a unified CLI for all services, and is cross-platform, with binaries available for Windows, Linux, and macOS.

Thingspeak:

- real-time data collection
- data processing
- Visualizations
- Some of it features are free

Amazon AWS:

Amazon Web Services (AWS) is the market leader in IaaS (Infrastructure-as-a-Service) and PaaS (Platform-as-a-Service) for cloud ecosystems, which can be combined to create a scalable cloud application without worrying about delays related to infrastructure provisioning (compute, storage, and network) and management.

With AWS you can select the specific solutions you need, and only pay for exactly what you use, resulting in lower capital expenditure and faster time to value without sacrificing application performance or user experience.

It provides below features for free for 1 months:

Amazon EC2 Service

Amazon S3 Service

Amazon RDS Service

Amazon Elastic Load Balancing

Amazon DynamoDB Service

Amazon ElastiCache Service

Amazon CloudWatch Service

Amazon SES Service

Amazon SNS Service

Amazon SQS Service

Amazon SWF Service

AWS Data Transfer In

AWS Data Transfer Out

AWS Support (Basic)

Microsoft Azure:

Microsoft Azure, popularly known as Windows Azure is a cloud computing platform built by Microsoft for building, managing and deploying the applications and services through the network of Microsoft data centers. It helps you move faster, do more and save money. Be it a small business or an enterprise, Windows Azure is capable of providing cloud computing services that can suit any need of internet solutions.

Here are some of the amazing features that Windows Azure offers:

Iaas and PaaS

Azure is the only cloud platform ranked as an industry leader by Gartner for both infrastructure-as-a-service and platform-as-a-service. It supports various programming languages, tools and frameworks and lets you build, deploy and manage applications any way you like.

Hybrid Ready

Some service providers make you choose between the public cloud and your data center. Azure offers you enterprise proven hybrid cloud solutions like amazon web services that can help you expand your IT options without added complexity. The data storage, backup and recovery become easier with Azure. Also, it becomes easy to build applications that span both cloud and on-premises.

Open and Flexible

Azure is open and flexible and supports any language, operating system, framework right from Windows to Linux, Oracle to SQL Server, C# to Java. It brings the best of Linux and Windows ecosystems and enables you to build robust Sharepoint applications and services that work well with every device.

Scalable and Economical

Azure is quite scalable and matches every demand so you can pay for what you use.

Azure free service for 12 months:

Linux Virtual Machines

Windows Virtual Machines

Managed Disks

Blob Storage 5GB

File Storage 5GB

SQL Database 250GB

VPN Gateway

Load Balancer

Azure Cosmos DB

Bandwidth (Data Transfer)

Notification Hubs

PCB Design Software:

We have two options for PCB design, First one is **KiCAD** and second is **Proteus**. Both are free and versatile. There are many tutorials available to learn from basic to advanced. These are steps to design PCB layout.

- Creating a Project
- Designing the schematic (Schematic using symbols and Wires)
- Lay out the board (Visibility options, Footprints, Traces and board outline)
- Improve the schematic (Power symbols, labels and electrical rule check)
- Improve the Layout (Updating from schematic changes, copper zones, vias, net selection and exchanging units)
- Get ready for manufacturing (Design rules and gerber export)

Final Solution: (Don't touch it for now, just after presentation)

(Block Diagram, Features, Hardware and Software Requirement, Milestones :Deliverables and Time Schedule):

Block Diagram:
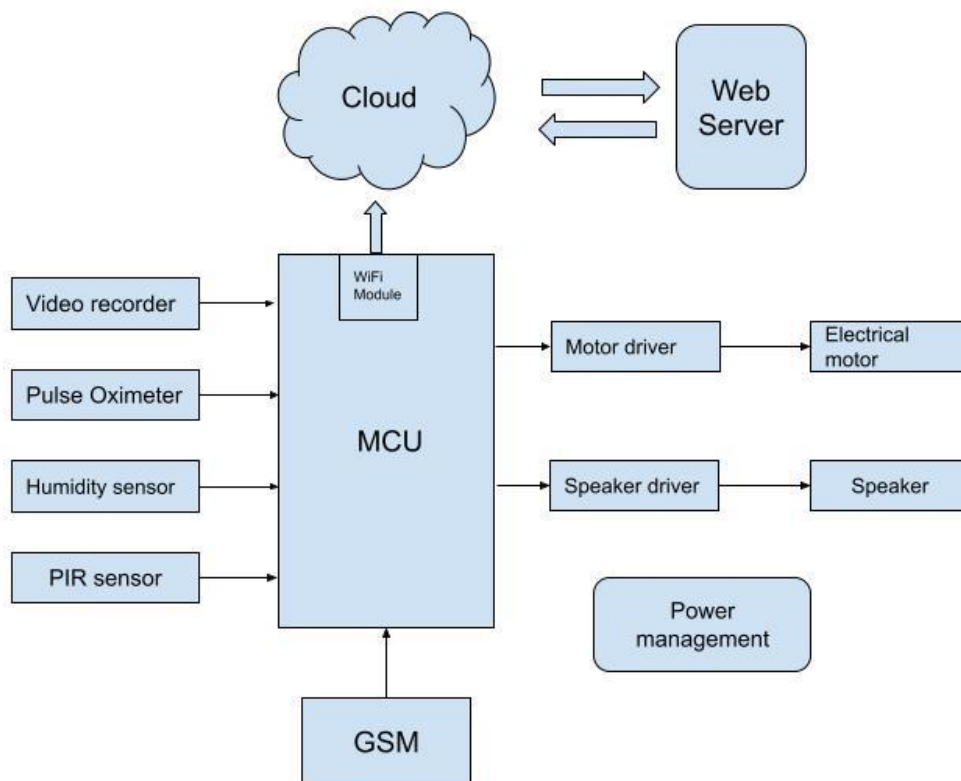
Features of our project:-

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● Swing control
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Software requirement:-

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- C language, C++ or Python
- Kicad
- PCB Wizard
- Microsoft Azure

Multitasking with Raspberry Pi -

Multitasking and multiprocessing have become a very important topic in microcontroller-based systems, namely in complex commercial, domestic, and industrial automation applications. As the complexity of projects grows, more functionalities are demanded from the projects. Such projects require the use of multiple interrelated tasks running on the same system and sharing the available resources, such as the CPU, memory, and input-output ports. As a result of this, the importance of multitasking operations in microcontroller-based applications has grown steadily over the last few years. Many complex automation projects now make use of some form of a multitasking kernel.
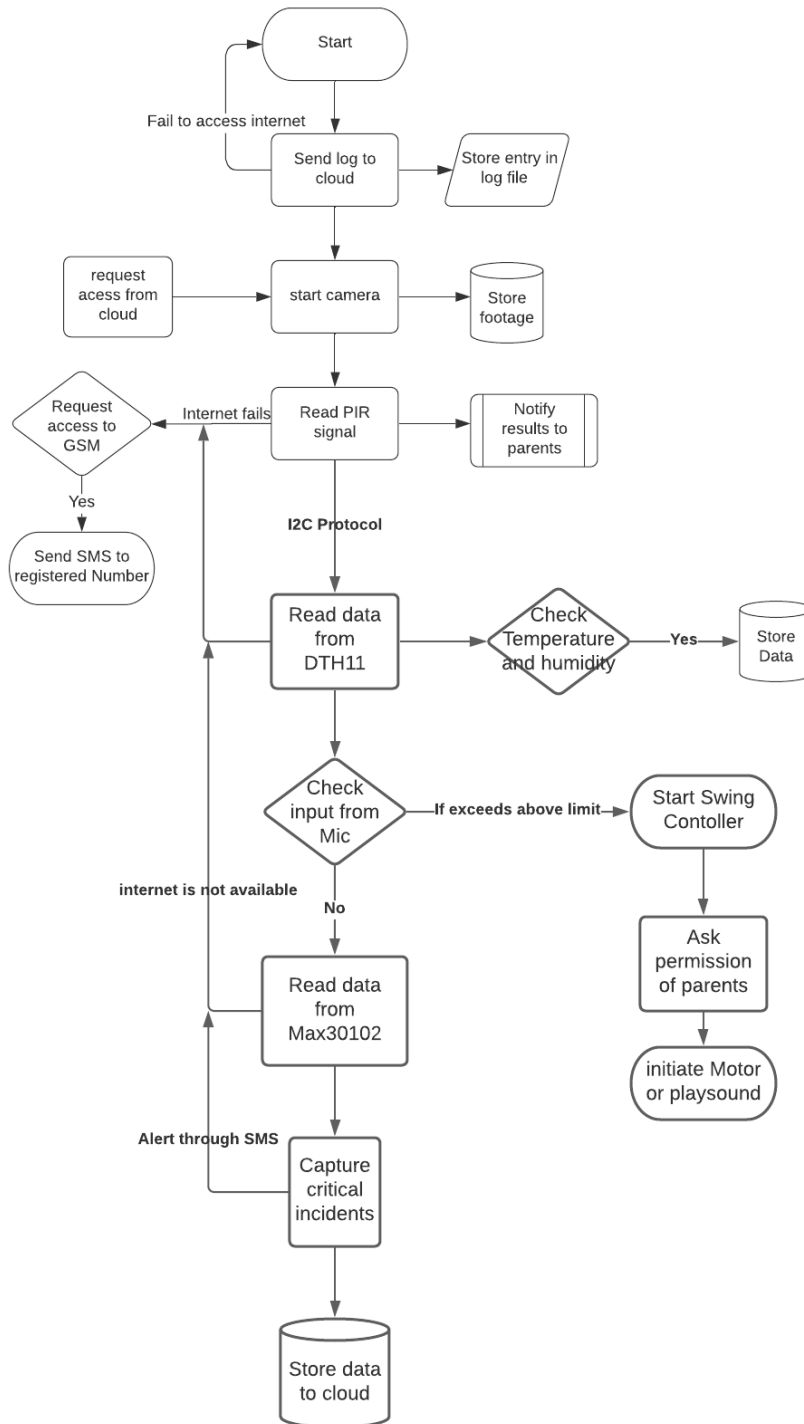
The following multitasking is supported by Raspberry Pi :
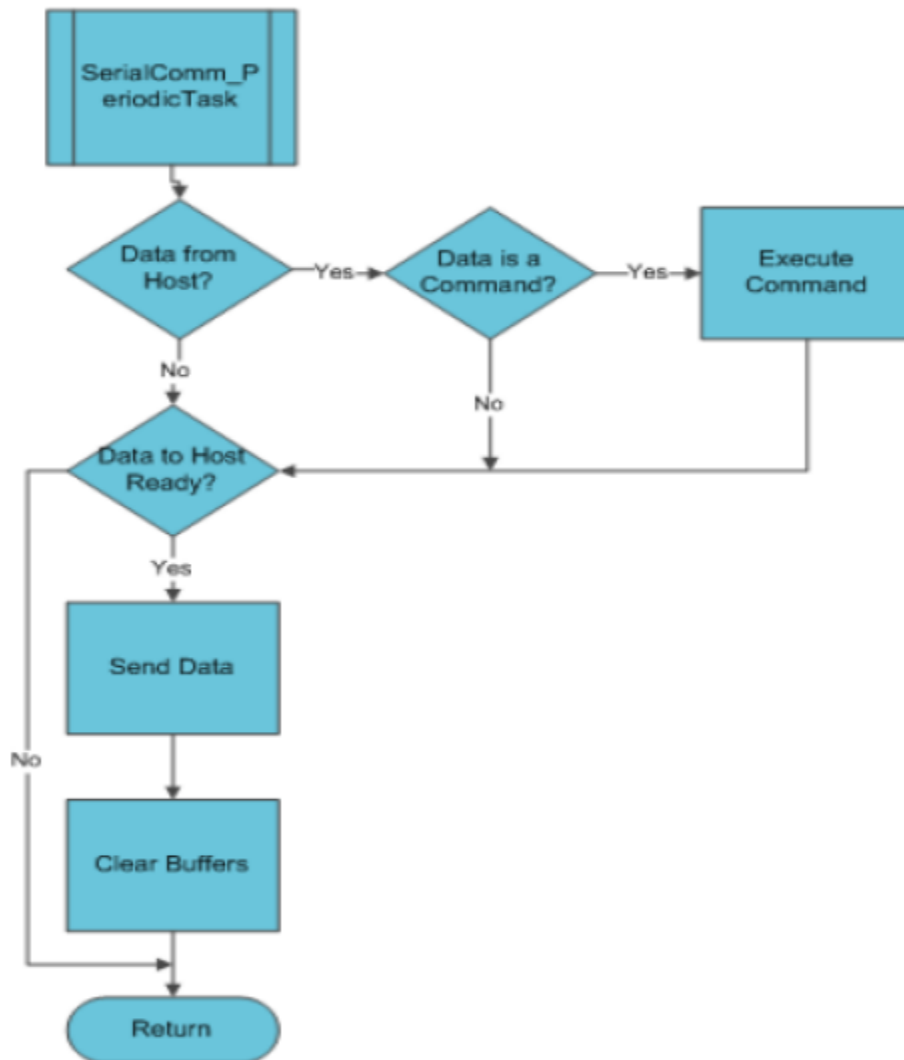
- Fork
- Thread
- Subprocess
- Multiprocessing

Scheduling algorithm available in Raspberry pi :

- Co-operative scheduling
- Round-robin scheduling
- Preemptive scheduling

FlowChart of whole system:

1) Pulse oximeter monitoring

2) Swing controller:

```
┌─────────────────────────┐
│      Check baby          │
│ Status(present/crying)   │
└─────────────────────────┘
             │
             ▼
    ◇ Baby inside crdle? ◇ ──Yes──▶ ◇ Check crying ◇ ──No──┐
             │                             │                │
            No                            Yes               │
             │                             ▼                │
             │              ┌─────────────────────────┐     │
             │              │    Start motor with      │     │
             │              │      gentle speed        │     │
             │              └─────────────────────────┘     │
             │                         Text                 │
             │                          ▼                   │
             │              ◇ Check still crying? ◇         │
             │                 │            │               │
             │                No           Yes              │
             │                 │            ▼               │
             │                 │  ┌─────────────────────┐   │
             │                 │  │    Swing cradle      │   │
             │                 │  │    and play music    │   │
             │                 │  └─────────────────────┘   │
             │                 │            ▼               │
             │                 │      ╔═══════════╗         │
             │                 │      ║ Store data ║        │
             │                 │      ║in database ║        │
             │                 │      ╚═══════════╝         │
             │                 │            ▼               │
             │                 │  ┌─────────────────────┐   │
             └─────────────────┴─▶│       Send          │◀──┘
                                  │  notification to     │
                                  │      parents         │
                                  └─────────────────────┘
```
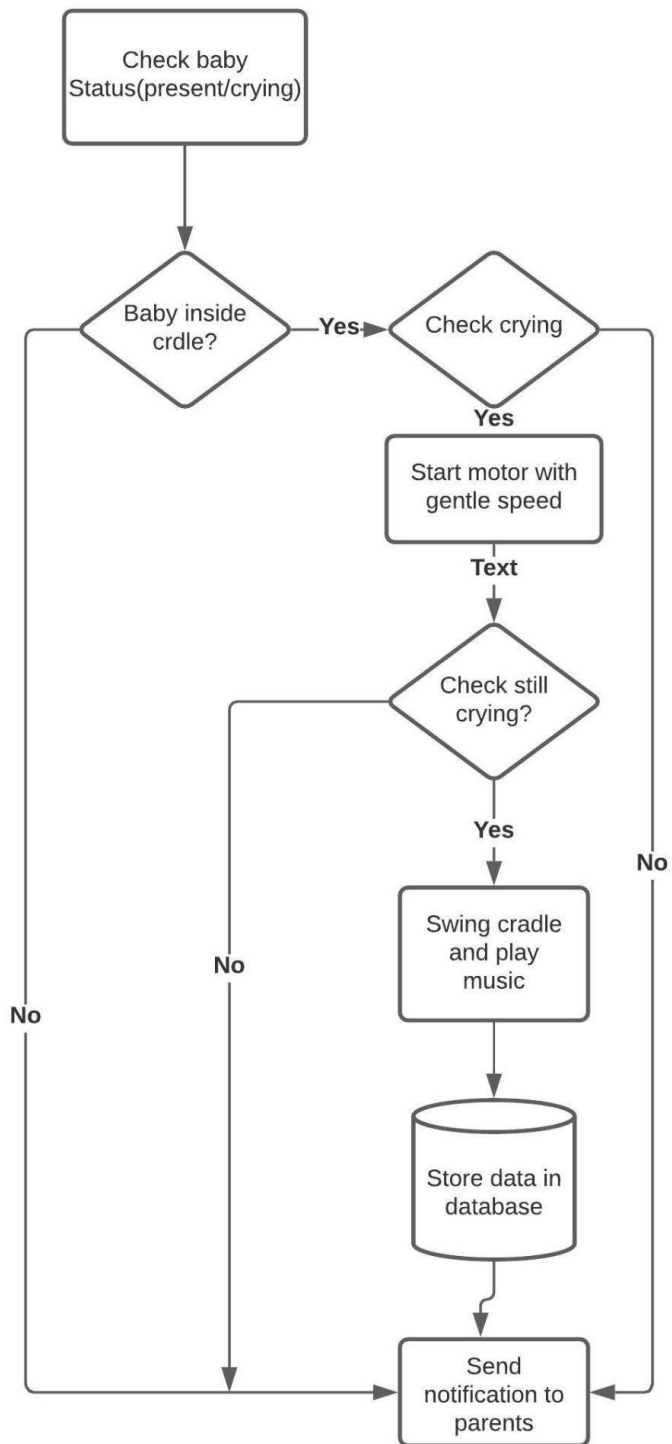
3) Crying Detection:

4) Wetness Detection:

```
Humidity sensor ──▶ ◇ Wetness detection ──Yes──▶ [ Measure RH% level ] ──▶ [ Measure temperature of bed ]
                          │                                                              │
                         No                                                              ▼
                          │                                                      ( Notify parents )
                          │                                                              │
                          ▼                                                              │
                    [ Send data to cloud ] ◀───────────────────────────────────────────┘
```

5) video surveillance:
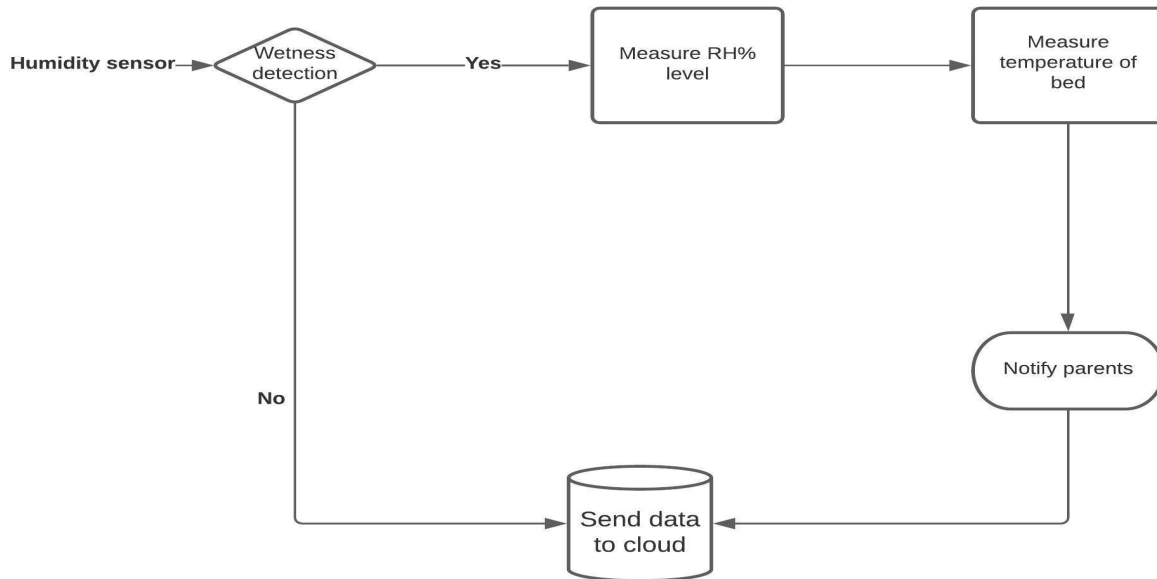
```
[ Image Sensor ] ──▶ ◇ Baby detection ──Yes──▶ ◇ Detect baby' position ──No──▶ ( Send message "baby is not sleeping on back" )
                          │                              │                                  │
                         No                    If sleeping on back                          │
                          ▼                              ▼                                  │
              ( Send message to parents )   [ Send message to parents "baby on back" ] ◀────┘
                          │                              │
                          └──────────┬───────────────────┘
                                     ▼
                               [ Database ]
```
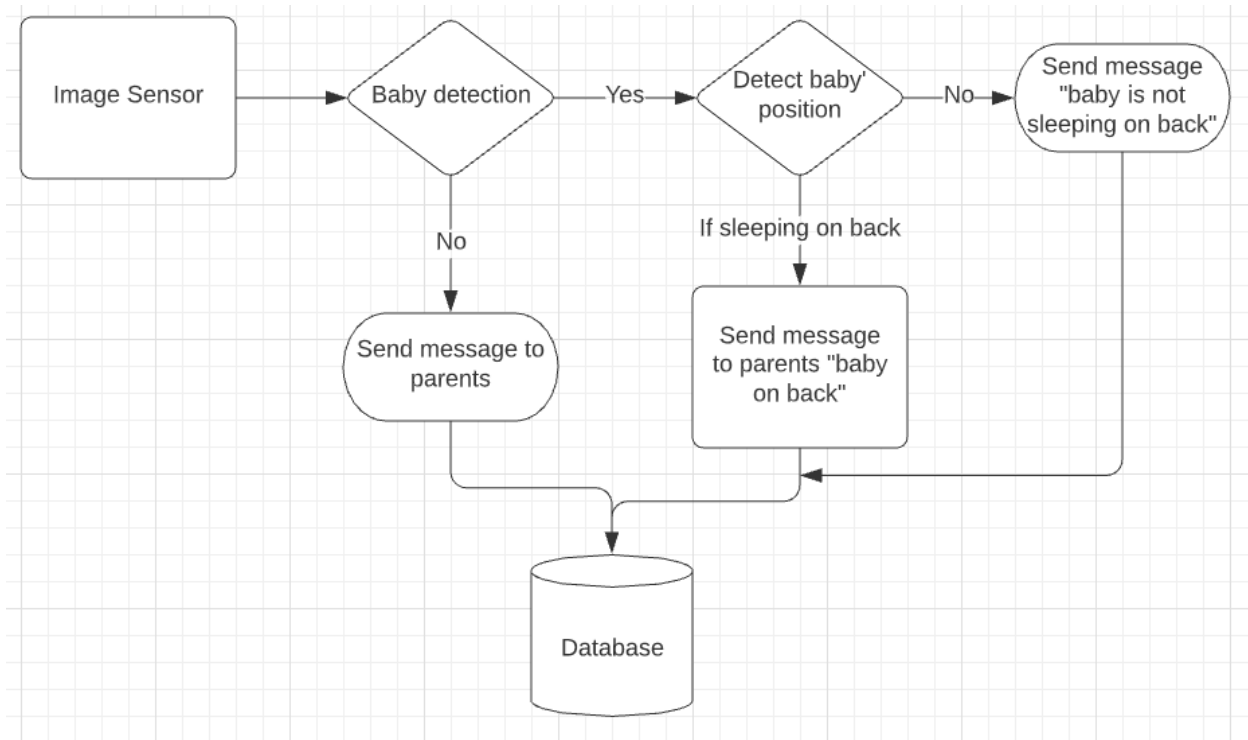
Sr. No.	Task	Start date	End date	Name
1.	**Project proposal**	**MAY 10,2021**	**JUN 03,2021**	**All group**
2.	**Designing circuit diagram and schematics using Kicad and Multisim**	**JUN O7,2021**	**JUN 10,2021**	**Rohan**
3.	**Final decision on choosing components and deciding where to buy from**	**JUN 11,2021**	**JUN 14,2021**	**Shahrukh**
4.	**Gathering information for all the components and their manual**	**JUN 15,2021**	**JUN 16,2021**	**Vandana**
5.	**Buying hardware components**	**JUN 16,2021**	**JUN 17,2021**	**Swapnil**
6.	**Configuring and testing Raspberry Pi**	**JUN 17,2021**	**JUN 21,2021**	**Vandana**
7.	**Designing and testing power supply**	**JUN 21,2021**	**JUN 23,2021**	**Swapnil**
8.	**Interfacing Raspberry Pi 3 with** Pulse Oximeter MAX30102	**JUN 24,2021**	**JUN 28,2021**	**Rohan**
9.	**Interfacing** RASPBERRY PI 3 with PIR sensor - HC-SR501	**JUN 29,2021**	**JUL 05,2021**	**Shahrukh**
10.	**Interfacing Raspberry Pi 3 with** Speaker - USB mini speaker from Adafruit	**JUL 06,2021**	**JUL O8,2021**	**Vandana**
11.	**Interfacing Raspberry Pi 3 with** Humidity sensor and GSM/GPRS module	**JUL 09,2021**	**JUL 12,2021**	**Rohan**
12.	**Interfacing Raspberry Pi 3 with** USB camera and microphone - Logitech	**JUL 13,2021**	**JUL 19,2021**	**Shahrukh**

	C920			
13.	**Connecting the system with cloud storage**	**JUL 20,2021**	**JUL 26,2021**	**Swapnil**
14.	**Interfacing all components and system together**	**JUL 27,2021**	**JUL 29,2021**	**Rohan**
15.	**Testing and debugging all the circuit and components together on breadboard**	**JUL 30,2021**	**AUG 05,2021**	**Shahrukh**
16.	**PCB design**	**AUG O6,2021**	**AUG O9,2021**	**Swapnil**
17.	**Zero PCB implementation**	**AUG 10,2021**	**AUG 11,2021**	**Vandana**
18.	**Final report Presentation**	**AUG 12,2021**	**AUG 16,2021**	**Group**
19.	**Final project Presentation**	**AUG 18,2021**	**AUG 19,2021**	**Group**

Instructor's Remarks:

Reference :

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utm_medium=cpc&utm_campaign=Shopping_Canada&gclid=CjwKCAjwhYOFBhBkEiwASF3KGZJ-b6jBx0Ghj4hY-UDM6P3FTeZnOGHBAC0F-E-fhKnxIiN73OhewBoCO7UQAvD_BwE

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15. Difference between servo Motor and DC Motorhttps://circuitglobe.com/difference-between-servo-motor-and-dc-motor.html#:~:text=The%20Servo%20motor%20comprises%20of,circuit%20and%20a%20position%20sensor.&text=Its%20rotation%20is%20limited%20to%20180%E2%81%B0%20whereas%20DC%20motor%20rotates%20continuously.

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.https://randomnerdtutorials.com/dht11-vs-dht22-vs-lm35-vs-ds18b20-vs-bme280-vs-bmp180

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