IOT HEALTHCARE SYSTEM FOR MOTHER-CHILD HEALTH AND EARLY DETECTION

By

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Abdullah Reda Darwesh

Mohamed Kamal Fawzy

Heba Ali Abdelbary

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
BACHELOR OF SCIENCE
in
Systems and Biomedical Engineering

Under the Supervision of

Prof. Ahmed Hisham Kandil

Professor

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Department
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Abstract

Infants, young children, and females are more prone to rapid physiological deterioration. Regular measurement and documentation of clinical (physiological) observations are essential for patient assessment and early recognition of clinical deterioration. The dominant orientation of our country according to the presidential initiative is females and newborns healthcare, the previous research highlighted the size of problems that this society category Suffered from based on cross-sectional data, that's why we observed different trials to solve these problems based on the collected data from different governments. Our intervention is different from previous trials, we will use the power of technology to support this society category. [1] Our project is an integrated IoT Healthcare System for Women and newborn Healthcare, the system aims to publish awareness about suitable nutrition, vitamins, early detection tests, vaccination, psychological health, family planning methods, and health service centers that provide it for pregnant women to control and reduce the problems thas females suffer from, in addition, Our IoT Kit helps also women and doctors to monitor a child's vital signals remotely to take a fast response at emergency time.[2]

Chapter 1 : Introduction

Motivation

Egypt is one of the most populous countries in the Middle East and the third most populous country in Africa; the current female percentage is 48.8% out of the total population, Forty percent of Egypt's population are under the age of 18. Egypt recorded the highest fertility levels in 2014 since it reaches 3.5.
Females and newborns are considered half of the Egyptian population and one of the most important categories in our society, at the same time they suffer from different healthcare issues due to lack of awareness about the suitable nutrition system, vaccination, vitamins, and boor tracking for vital signals.[3]

Every woman and child have the right to a decent healthcare system to live normally, this healthcare system can guarantee the quality of life that will shape the health, education, economical level of our population.
We believe that women and children are the backbones of any community, if they have a healthy life, the community will be very powerful so, we try to save their life and help every woman to stay healthy and build a stable family using the power of technology.

Background

Egypt was one of six countries that supported the 1990 Summit Conference for the Protection and Development of Children, which strongly endorsed safe motherhood programs and strategies. In 1994, Egypt hosted the International Conference on Population and Development in Cairo. Reducing maternal mortality has also been a key goal of the national five-year plans of the Ministry of Health and Population (MoHP) and women's and children's right to health is enshrined in Egypt's new constitution.
According to recent UN maternal mortality estimates, Egypt has reduced its maternal mortality ratio (MMR) from 120 in 1990 to 45 in 2013, a 62.5% reduction. The updated estimates also produced a new MDG MMR target of 30/100.[4]

The share of under 5 deaths occurring in the first month of life is now 56% in Egypt. Causes of neonatal mortality are different from those in older children, related primarily to preterm and complications during birth. Addressing neonatal causes of death will be key to reducing under 5 mortality even further. The rapid decline in MMR is likely attributed to several factors, including contraceptive use among married women which rose to 60% in 2008 from 38% in 1988, and increased rates of antenatal care (ANC) (66%) and skilled attendance at birth (79%). Although Egypt has a sufficient number of health providers, the health workforce is distributed unequally, with a particularly low level of providers in rural Upper Egypt. Overall coverage of births attended by skilled health workers is around 80%, compared to just over 40% between 1990 and 1995. However, the poorest rural residents still

have just over 60% of births attended by skilled staff, compared to over 90% in wealthy urban parts of the country.[4]

Information has played a key role in Egypt's success in reducing maternal and child deaths. Data obtained from the 1992 and 2011 National Maternal Mortality Studies and the Maternal Mortality Surveillance System, These studies highlighted key causes of maternal mortality related to substandard care from obstetricians. This resulted in several efforts to improve the quality of delivery care, including the National Child Survival Project (1990-1996), the Mother Care project (1996-98), the Healthy Mother/Healthy Child Project (1998-2004), and the UNICEF project (1996 to present). These have successfully reduced maternal mortality, particularly in poorer Upper Egypt.[5]

Egypt tries to increase healthcare services through Immunization protocols, Infection control, Family planning services, and Integrated management of childhood illness (IMCI)

Lack of complete and reliable data affects the use of health information for decision-making. Deficiencies in quality, timeliness, and use of data need to be addressed so that health organizations can continue to plan and target strategies toward the most in need. This effort should continue to be complemented by appropriate research, evaluations, and assessments. [6]
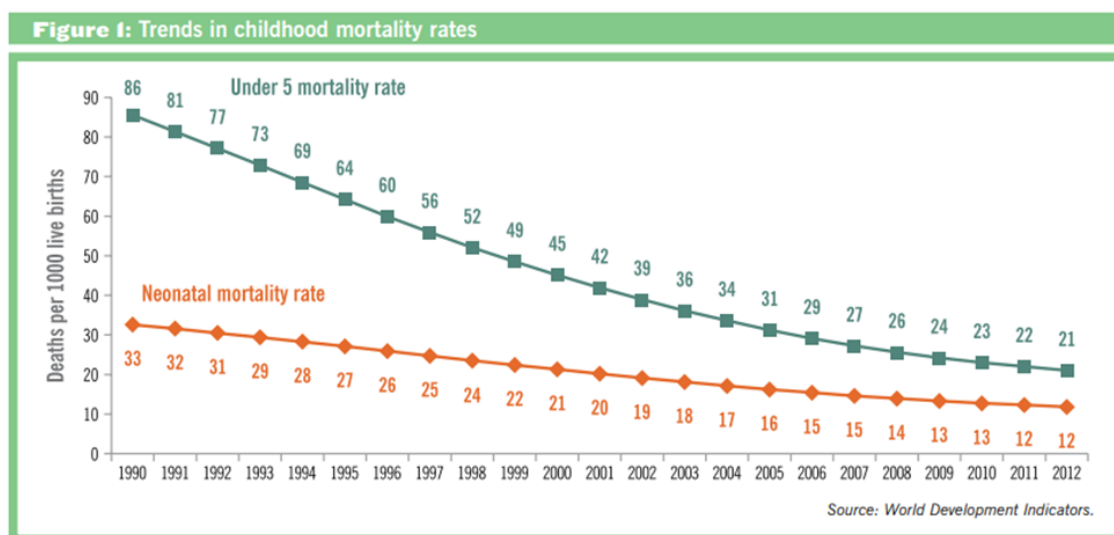
Fig.3.1 Trends in childhood mortality rates

Project Smart Goals

Long Term Goals:
Improve Mother-Child Healthcare System in Egypt by December 30, 2027. Starting from monitoring children's vital signals and streaming them to private and public clinics, public and private hospitals, and homes to facilitate decision making to be faster, easier, and more accurate. In addition to publishing general awareness among 90% of our population females to help them to be healthier.

Intermediate Goals:
By December 30, 2025, we will cooperate with the Ministry of Health and UNADS to publish our IoT kit in public Health Centers in the main governments then in Upper Egypt at the second stage and publish awareness through our mobile app and website among 70% of females in Cairo.

Short Term Goals:
By September 30, 2023, we will sell our kits directly for 10% of females in Cairo and cooperate with private clinics to install our system and test it then integrate it with their patients who buy our kits.

By December 30, 2023, we will translate our integrated healthcare system to the Arabic language to publish awareness about females Healthcare in 10 Public health centers through installing our mobile app.

Gantt Chart

| | Sep 2020 | Oct 2020 | Nov 2020 | Dec 2020 | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Aug 2021 |

Untitled section

- Study Angular and Spring Boot
- Study Angular and Spring Boot
- Study Embeded System and Embeded C
- StudyFlutter
- Create Flutter App
- Create Angular Web App
- Create Spring Boot App
- Identifying IoT kit design and components
- Home Page (GUI)
- Build Resources screen from static content (Flutter)
- Create TimeLine page and Blog (GUI)
- Security (Server)
- Play video content from youtube (Flutter)
- Create Blog table (DB) and Timeline Controller (Spring Boot)
- Log in and Sign up and Validation (GUI)
- determine the vital signal that can be mesured using our kit
- Baby Monitoring (Server)
- Add comments and Likes (GUI)
- Developing MAX30100 sensor readings
- Baby Monitoring (GUI)
- Build Profile screen and Health screen (Flutter)
- create Comments and Likes Tables (Server)
- Developing MPU6050 sensor readings
- Developing DS18B20 sensor readings
- Developing MAX30105 sensor readings
- Developing I2C comunnication protcol for the kit
- Find way to write blog to contain imges and videos (GUI)
- Clendar and Event Handler (Gui)
- get and make mock data to display sensor data
- Edit and Delete Blog (GUI and Server)
- Handling timer and interrupt
- Clendar and Event Handler (Server)
- Reimplement Timeline in a better design (GUI)
- Notification Handler (Server)
- Add my blogs tap (GUI and Sever)
- Build Timeline Screen (GUI)
- Notification Handler (GUI)
- Add liked blogs tap (GUI and Sever)
- Add notificatlion to timeline (GUI and Sever)
- Handling design pattern
- Add new Blogs tap (GUI)
- Streaming Data to mobile app and website
- correct Timeline errors (GUI and Sever)
- Security (Spring Boot)

	ACTIVITIES	ASSIGNEE
	Untitled section	
1	✅ Study Angular and Spring Boot	Abdulla Elsayed
2	✅ Study Angular and Spring Boot	mohame kamal
3	✅ Study Embeded System and Embeded C	Heba Ali
4	✅ StudyFlutter	Abdullah Reda Drwesh
5	✅ Create Flutter App	Abdullah Reda Drwesh
6	✅ Create Angular Web App	Abdulla Elsayed
7	✅ Create Spring Boot App	mohame kamal
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40	✅ Handling design pattern	Heba Ali
41	✅ Add new Blogs tap (GUI)	mohame kamal
42	✅ Streaming Data to mobile app and website	Heba Ali
43	✅ correct Timeline errors (GUI and Sever)	mohame kamal
44	✅ Security (Spring Boot)	Abdulla Elsayed

Market Research

Our plan consists of two stages, we will implement these two plans during The AUC competition.

Target audience:
- Our target audience is females from 21 to 45 years old, we are interested in women before, during and after pregnancy.
- Married males, they have huge responsibilities towards the wife and the children healthcare.

Targeted location:
- First stage: Cairo
- Second stage: Upper Egypt

Primary Research method:
- Online campaign through online meetings to collect data from users and spread our application.
- We will co-operate with Public Health Centers to install our system on the phones of the targeted patients and to make patients fill a form.
- We will go to universities to spread our application and collect data from female students

Secondary research method:
- Collect data from user's interaction with our application
- Data from The National Council of Women

Compotators:
1. BabyScripts

- **Babyscripts (getbabyscripts.com)**

- Provide mothers with three services (Follow Up with doctors, Pregnancy tracking remotely, IoT kit for measuring vital signals)

2.Glow Baby

- **GLOW. Baby Tracker & Feeding, Diaper, Sleep Log - Apps on Google Play**

- Keep track of everything from bottle feeds to sleep schedules and get valuable info about starting solids, developmental milestones and much more. Plus, get personalized parenting tips delivered daily**.**

SWOT Analysis

Strengths	Weakness
1. Ability to monitor baby remotely. 2. Experience in medical field and its technologies. 3. Good network with people who work in medical field. 4. Good team in developing. 5. Easy interface with mobile & web applications.	1. Need good team in marketing. 2. Poor healthcare infrastructure in Egypt. 3. Possibility of poor service of doctor or hospitals. 4. Limited Fund.
Threats 1. There are startups provide some services like us. 2. Challenges in adopting new technologies. 3. Refusing of doctors and hospitals to use our application. 4. Resistance from mothers to use our IoT Kit.	**Opportunities** 1. Funded from different organizations or investors because we address a very important problem in Egypt. 2. Lack of dominant competition. 3. Integrate with other companies providing needed services. 4. We will maintain highly responsive customer service.

Chapter 2 : Literature Review

First-time parents may be particularly challenged, as they may feel unprepared to care for their infants. They may rely upon the Internet and mobile applications or peer review for support in handling day to day parenting situations. Health care professionals and app developers have introduced numerous apps to support parenting, However, parents continue to report difficulty locating apps that meet their needs due to the proliferation of irrelevant and low-quality apps. There is a list of apps on Google play store and Apple store that divided into two categories:

- Tracking apps that allow parents to track babies' basic activities and movements.
- Information apps that provide parenting information such as infant feeding, age-appropriate activities, first aid, and more.
- Sleeping-aid apps that presented white noises and lullabies to soothe infants and induce sleep.
- Photo sharing apps that permitted parents to share baby moments privately with loved ones. [7]

   The system features are:
   - Baby Monitor 3G supports both Wi-Fi and cellular 3G/LTE networks

   - Activity log
   - Baby Monitor 3G allows you to check, baby temperature, heart rate, SPO2, and baby position.
   - Multiparent support.
   - Alarm System.
   - Awareness Healthcare Blogs.

Healthcare Systems for females and children become very important today because it helps every female to stay healthy, track her healthcare system, track her child health too educate herself and tack a fast response.

Through IoT kits, a child's vital signs are measured over time and compared with the normal range for their age group. This allows pediatric health care providers to ensure that the child is growing the way they should.

By comparing a patient's vital signs to those in the normal range, we can also spot red flags for disease or physiological abnormalities. Consider how vital signs are used as diagnostic tools, detecting abnormal vital signs may help caregivers detect an otherwise invisible issue; understanding the normal ranges for each vital sign, doctors can quantify exactly how much of a deviation their patient is experiencing. This can help classify the severity of an illness and may be an important metric that health care

providers use to decide to monitor a situation more closely or begin immediate treatment.

Vital signs provide important information about how well a pediatric patient's organs and bodily systems are functioning. When a patient falls within the range of normal pediatric vital signs, that suggests that the organs are all working optimally, and that important bodily processes are being carried out efficiently. A deviation from normal pediatric vital signs raises a red flag that something may be wrong.[10]

The importance of this kind of kits are:

1. Remotely Monitoring
2. Abnormal tracking of heart rate may reveal a birth defect or a case of hypothermia. For older children, an abnormal heart rate can suggest a structural problem with the organ itself.

3. Provide doctors and nurses with readings to check blood oxygen levels if the patient has a specific problem, such as shortness of breath or pain in their chest.
4. For those who do have abnormal oxygen saturation levels, it may point to underlying conditions such as asthma or a structural malformation of the heart.
5. check temperature is whether the patient has a fever. If so, this typically means the body is fighting an infection. A high temperature can be an important diagnostic indicator.

Literature Review Matrix Template

Author/ Date	Source	Methods	Results	Comments
Nancy Baby Monitor 2017	Baby Monitor www.babymonitor3g.com	1. Mobile Application 2. IoT Kit	• Live video stream • Unlimited reach • Baby Monitor 3G supports both Wi-Fi and cellular 3G/LTE networks • Baby Monitor 3G allows you to check, how often was your baby awake, discover its sleeping patterns and replay sounds from current or any previous monitoring.	The system is effective in measuring the baby position and sleeping patterns.

			• Talk to your baby	
Anila Virani Linda Duffett-Leger 2019	mHealth	1. Mobile application 2. parenting apps 3. Mobile App Rating Scale (MARS)	• Baby Tracker has the most tracking options • as well as additional features such as white noise, lullabies, baby book, and information. • This app might be more suitable for parents who prefer a multifunctional app and would like to track more than just basic activities. • the Child Growth Tracker is solely designed for recording infants' growth such as height, weight, head circumference, and body mass index (BMI). Over time. • frequency of infants' basic activities reduces some parents only like to monitor their growth by years.	Parenting can be challenging, and in this digital age, first-time parents actively access mobile applications to adjust to their new roles. Apps are now technologically- parents' go-to tool for accessing information, tracking their babies' development, editing and sharing photos, and much more. While apps have the potential to make parenting easier, the abundance of low-quality apps makes the process of finding a reliable one arduous for parents

Chapter 3 : MATERIALS AND METHODS

In this section we will explain each project feature, the methods used to implement this feature and the materials needed during implementing the feature. Here we will explain the feature that we will talk about:

- Security
- Baby Monitoring
- Scheduler
- Notification Handler
- Parenting Information (blogs and videos)

3.1 Security

We focused on the security in this project to learn concept and new technologies used in security, so we used spring security in spring boot to implement security. In next point we will take about spring security structure and role of each element in this structure.

3.1.1 Authentication

Spring security authentication structure, elements and workflow

Structure:
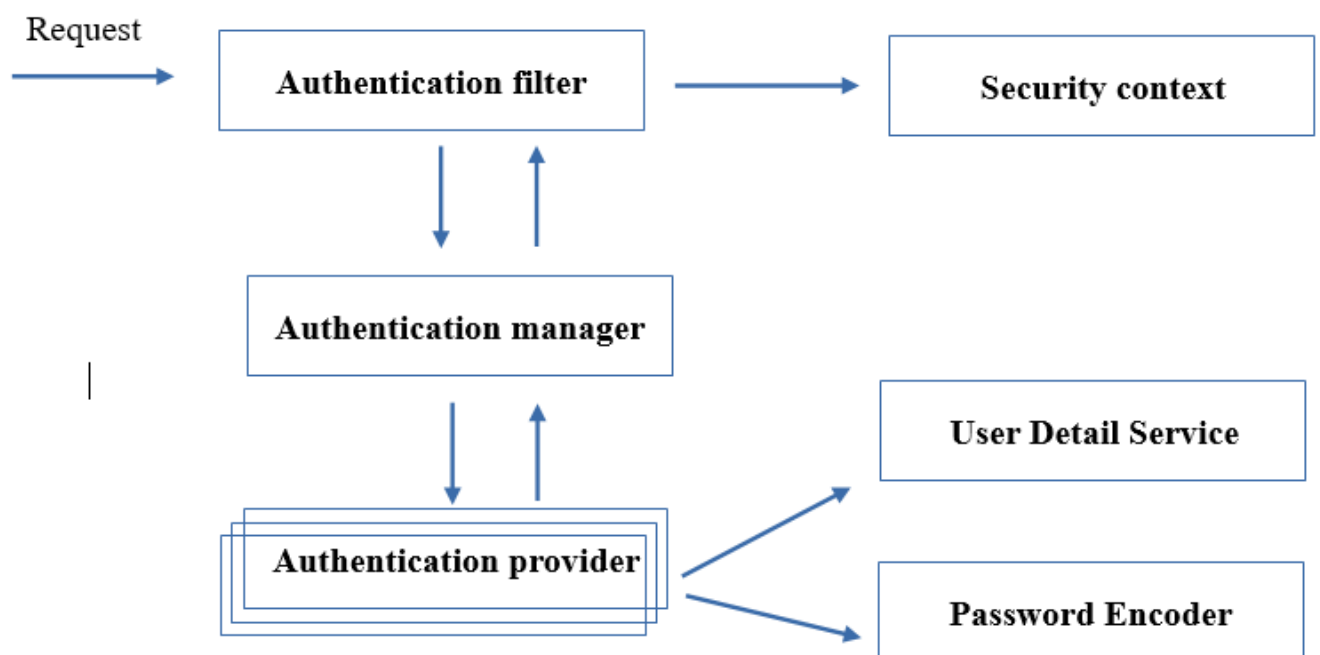
Elements:

- **Authentication manager:**
  Responsible for finding the correct authentication provider.
- **Authentication filter**:
  Intercept request to authenticate it by delegating to authentication manager.
- **Authentication provider:**
  Contain the logic of authentication that will be applied on the request.
- **User Detail Service**:
  Responsible for getting user credentials saved in database, LDAP or whatever.
- **Password Encoder:**
  Responsible for Checking if password is correct or not.
- **Security context:**
  Responsible for saving details of users logged in.

Workflow:

1. Authentication filter intercept request and delegate it to authentication manager
2. Authentication managers choose the convenient authentication provider and delegate request to it.
3. Authentication provider uses user Details Service and password Encoder objects to get user from data source and match the password with the one of the requests.
4. Result of authentication logic of provider return back to the filter.
5. Authentication filters save the user in security Context object if authentication succeed.

3.1.2 Oauth2.0

It is a standard way which is all about how a user delegate a client which can be mobile application or web application to access his resources from a server and it has many workflows which are called grant types as:

1) Authorization code

2) Password grant type

3) client credentials

4) Refresh token

we have used password and refresh token grant types together in our security system as it is the simplest one and the most convenient one for us because there is no third party application in our system until now at least, Like Facebook or google they use authorization code only with third party apps.
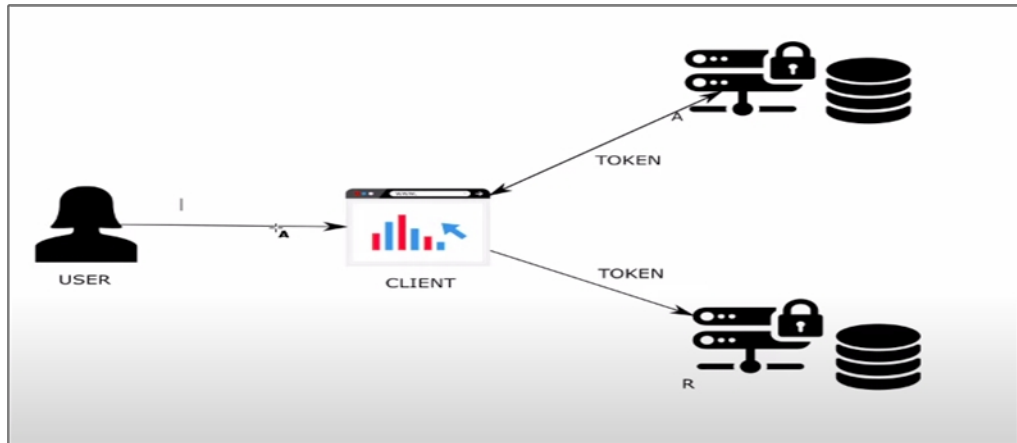
It depends on returning token to the client allow it to access user resources without having to sending his credentials every request, and this token expires too for safety so you should refresh it after some time. It is more flexible and better to user token and exactly json web access token (JWT) because of many reasons as token are stateless which means it contain all information needed for authentication, the server does not have to save the token, fine grained access control as the token itself contain user roles and permissions.

3.2 Baby monitoring

In our project we have worked on monitoring baby vital signs like temperate, heart rate and oxygen in blood (SPO2), then sending it to server to stream these data to the applications to display them for mother. In the following points we will talk about the main components used in this system and technology used to stream the sensors data.

3.2.1 IoT kit

We used esp32 which is system on chip microcontroller with WiFi module, Temperature sensor (DS18B20), heart rate and SPO2 sensor (MAX30105) and position and room temperature sensor (MPU). We used the layered architectural design pattern which consists of three layers which are:

- ◆ Microcontroller abstraction layer (MCAL)
  - ➢ Network module
  - ➢ Digital input/output module (DIO)
- ◆ Hardware abstraction layer (HAL)
  - ➢ HTTP module
  - ➢ MPU module
  - ➢ MAX30105 module
  - ➢ DS18B20 module
- ◆ Application layer
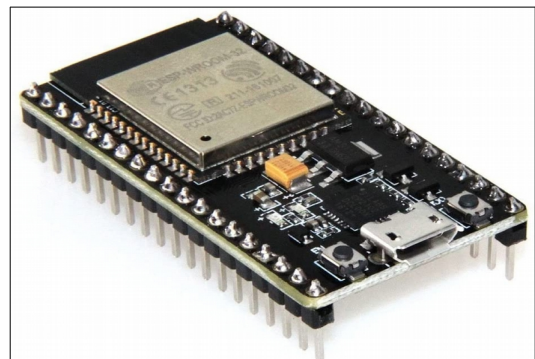
3.2.1.1 Kit components

MPU6050

- The MPU-6050 IMU (Inertial Measurement Unit) is a 3-axis accelerometer and 3-axis gyroscope sensor.
- The accelerometer measures the gravitational acceleration, and the gyroscope measures the rotational velocity.
- Additionally, this module also measures temperature.
- The gyroscope measures rotational velocity (rad/s), this is the change of the angular position over time along the X, Y and Z axis (roll, pitch and yaw).
- This allows us to determine the orientation of an object.
- It communicates through a standard I2C-compatible interface.
- Operates at 3.5v.
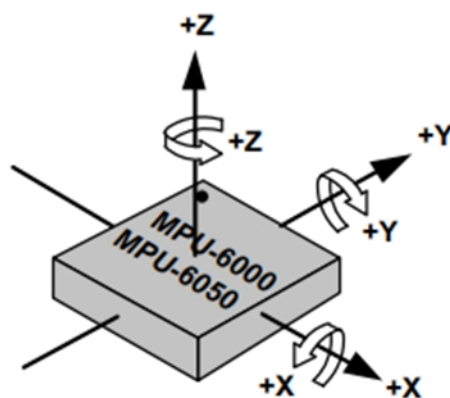
MAX30105

- The MAX30105 is an integrated particle-sensing module.
- It includes internal LEDs, photodetectors, optical elements, and low-noise electronics with ambient light rejection.
- The MAX30105 provides a complete system solution to ease the design-in process of heart rate and SPO2 detection applications.
- The MAX30105 operates on a single 1.8V power supply and a separate 5.0V power supply for the internal LEDs.
- It communicates through a standard I2C-compatible interface.

DS18B20

- DS18B20 temperature sensor is fairly precise and needs no external components to work. It can measure temperatures from -55°C to +125°C with ±0.5°C Accuracy.
- The resolution of the temperature sensor is user-configurable to 9, 10, 11, or 12 bits. However, the default resolution at power-up is 12-bit (0.0625°C precision).

  - Power Supply   3V to 5.5V
  - Current Consumption   1mA
    Temperature Range -   to 125°C 55-
  - Accuracy   ±0.5°C
  - Resolution   to 12 bit (selectable) 9
  - Conversion Time
                                               750ms >

3.2.1.2 Power consumption:

- Our IoT kit consume 5v and 128 mA.
- The battery lasts for 24 hours.

3.2.1.3 Alerts and Notifications:

- The success of the system lies in taking appropriate actions after observing a child's performance. To let the parents and health instructor know about the child's activities, alerts and notifications are mandatory.
- When a child is in danger, an immediate alert is generated to aware the parents or instructor. But when it is about their scorecard, it will be sent like a simple notification.
- We applied the mechanism of ITTT (If This Then That)
- Real-time Health Monitoring for vital signals

Firstly, the IoT kit should connect to the server by sending HTTP request to endpoint, then device is saved as connected and clients can start subscribing to it. After that the IoT kit start pushing the data to the server and the server forward this data to all subscribed clients. IoT kit sampling data sensor every 3 second and send to the server.
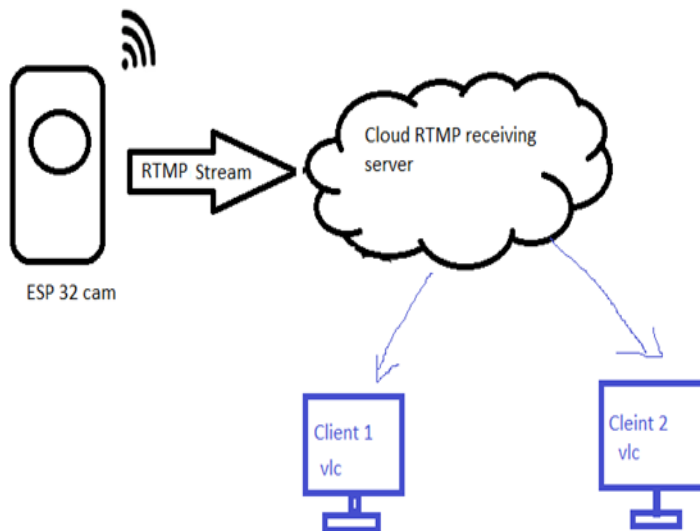
3.2.2 Server

There are many ways for streaming data such as server-sent events (SSEs), polling, WebSocket etc.…, but we have chosen server-sent events technology instead of others for more than one reason such as:

◆ SSEs are sent over traditional HTTP and does not need a special protocol.
◆ It has automatic reconnection when connection is lost.
◆ It is unidirectional way for sending data from server to client according to our needs.
◆ It is simpler in its implementation than some other technologies.
◆ It does not have problems with some firewalls like WebSocket protocol.

 Our server can handle many kits connection with many clients in the same time but the number of HTTP requests in our server is limited as we use local free server which is tomcat, so it can only handle nearly 200 requests in the same time
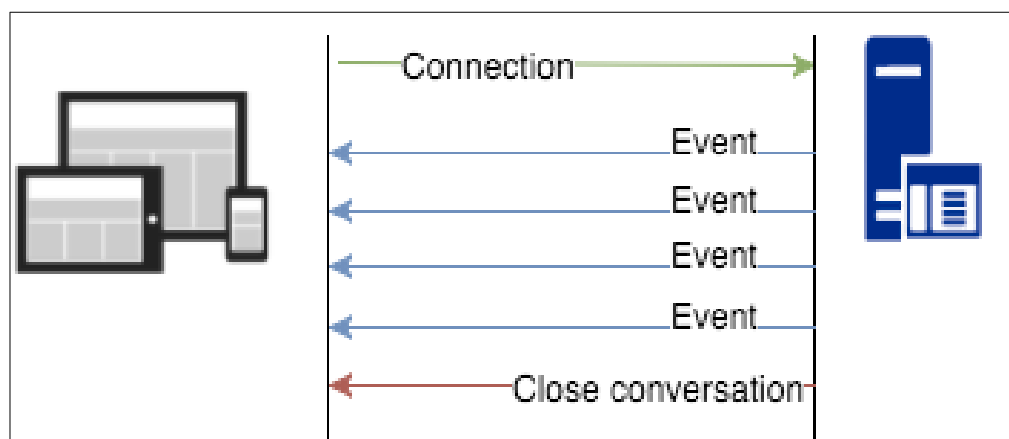
3.2.3 Clients (web and mobile)

➔ **Adding Devices**

For receiving sensors data from the server, Clients must add the device by sending HTTP request with device id to the server to check if this device id is correct to that user or not. After Adding the device, the server sends back SSE object if the device is connected and the clients listening to it. The user can add multiple devices.

➔ **Displaying Data**

For every connected device, there is data associated with it and the user can

switch between them. The data is displayed by:

- ◆ Graph for each vital sign
- ◆ Value for room temperature
- ◆ Animated images for the baby position

3.3 Scheduler

We have implemented scheduler for handling user important events and track the upcoming events with continuous update for them, but this feature exists only on the web application. You can add, edit and delete the events you can also set alarm but we are still working on it so it may be a future work.

3.4 Notification handler

The notification handler has been implemented in a way like data streaming, we have used server-sent event technology, so the server can notify the clients with some events when happen, these events are:

- ◆ Anything wrong in baby vital signs.
- ◆ If any user device has connected to the server.
- ◆ Notify that user does not fill some information so it appears as popup window.

All this notification is identified in client application with different text message

3.1 Awareness Information

In our system we provide the females with information for awareness about maternal health and their babies and children health.

The information is divided into two categories :

- ◆ General information which is installed with mobile or loaded statically on web
  This initial information provides basic data required to be healthy and safe pregnant woman.

It divided into :

- Covid19
- Baby
- Breastfeeding
- Exercise
- Labor and Delivery
- Vaccination

This information can contain video content from YouTube and other useful links on the web.

◆ Timeline blogs is divided into two categories which are`:
  - Doctor blogs
  - User blogs

User can also add any blog to his favorite blogs page to return to this blog easil.

Used Technologies:

Server : Spring Framework

Database: Mysql

Wep app : Angular

Mobile : Flutter

Chapter 4. Results and Discussion

4.1 Website

Main features on the website

1. Home Page

2. Sign up/ Login page

3. Calendar

4. Awareness Blogs

- Nutrition

- Vaccination

- Exercise

- Covid-19

- Breast Feeding

- Delivery and Labor

5. Baby Monitoring

6. Tracking Baby Monitor (Alarm System)
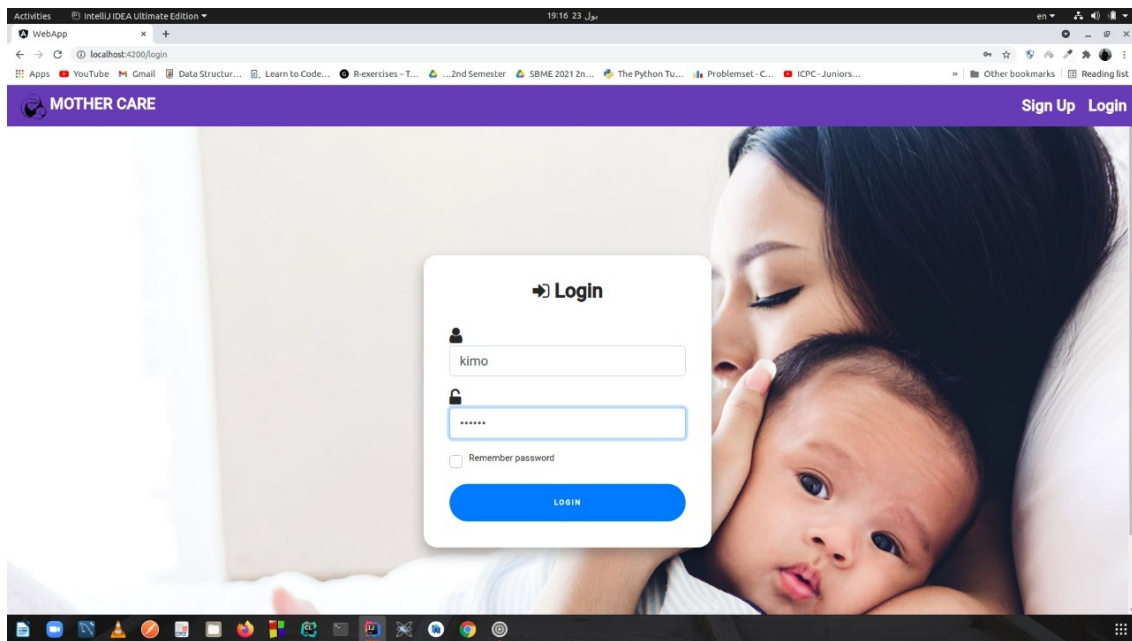
Fig.2 Login and signup page
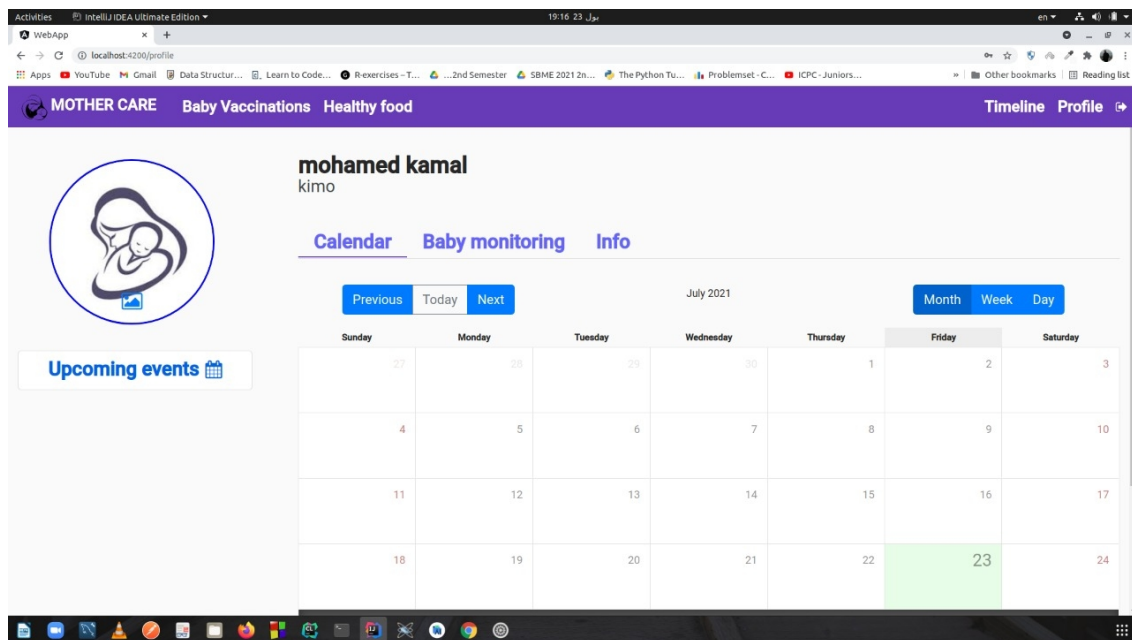
Fig.3 calendar
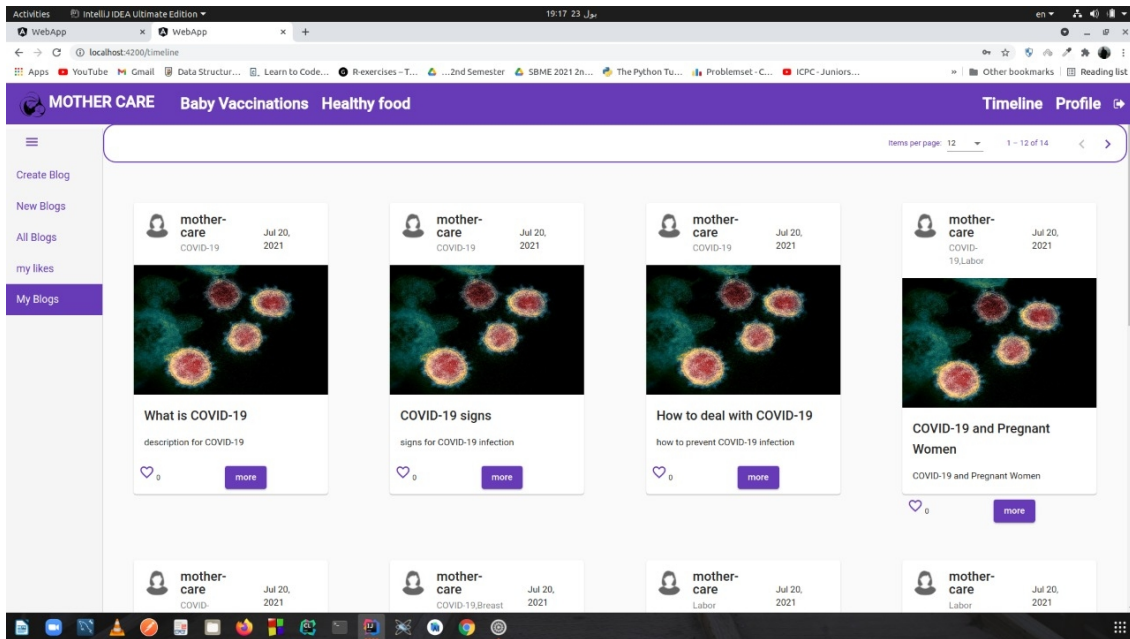
Fig.4 awareness blogs
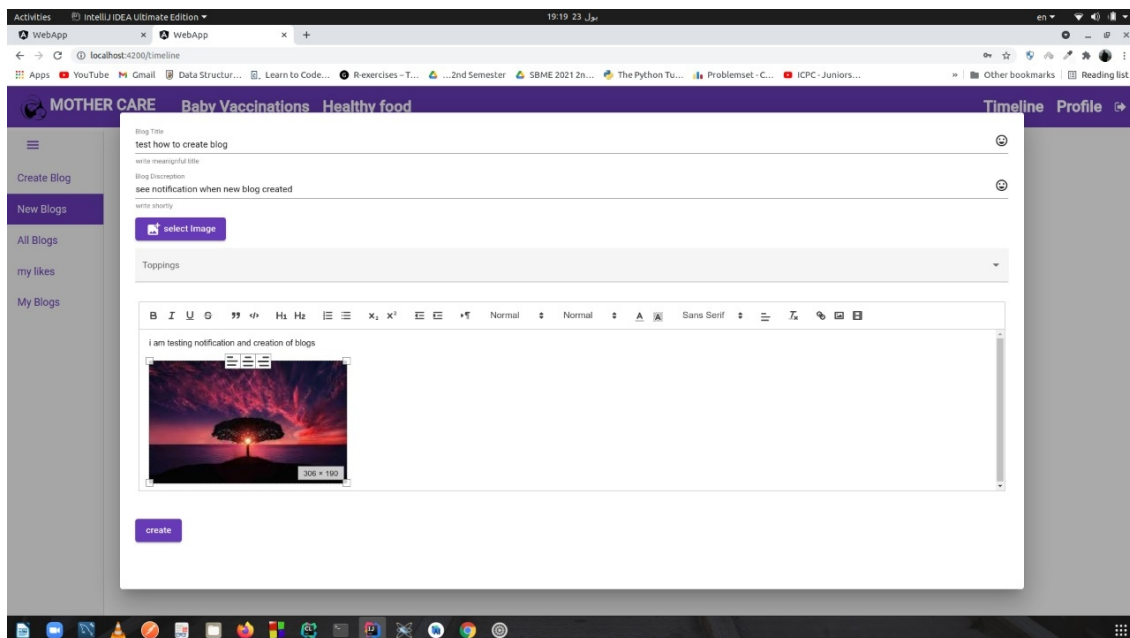
Fig.5 Add new blog
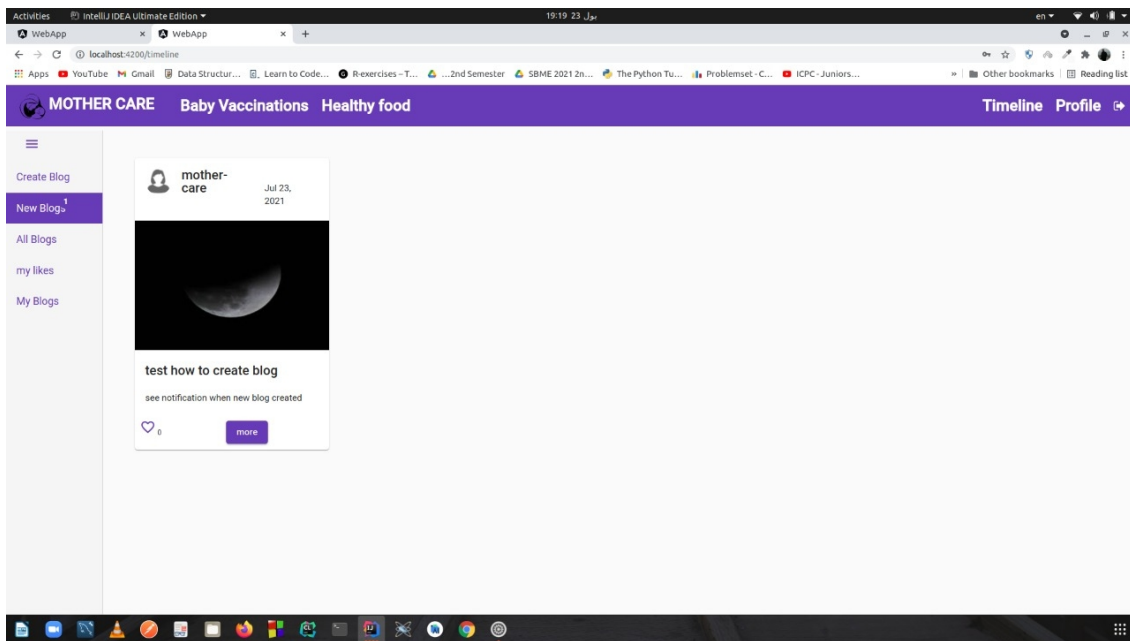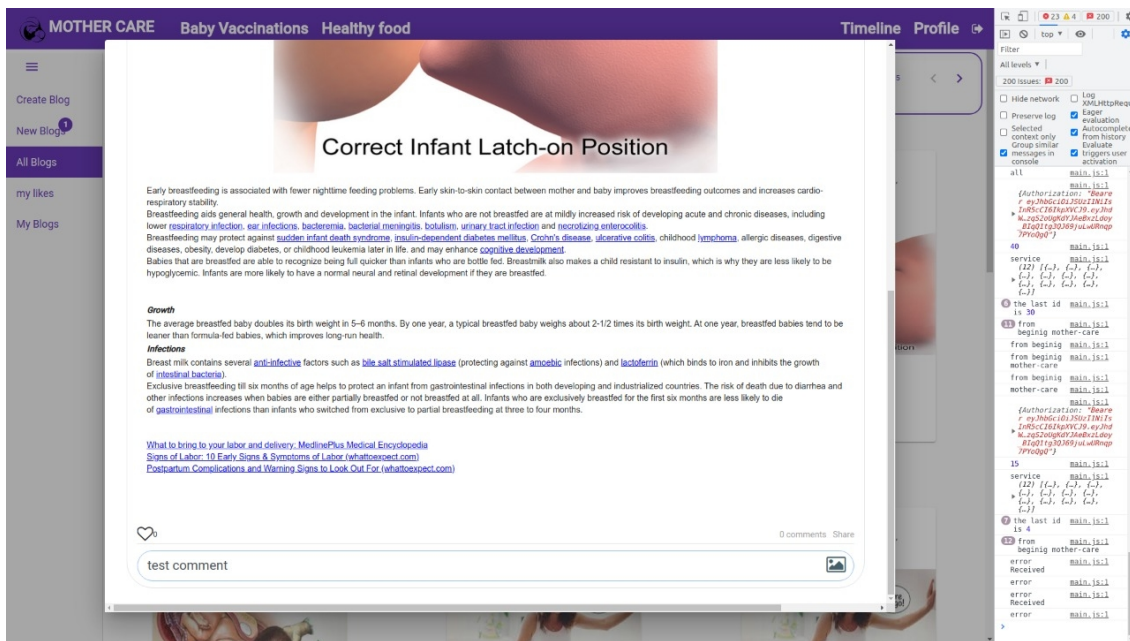
Fig.6 Display new blogs
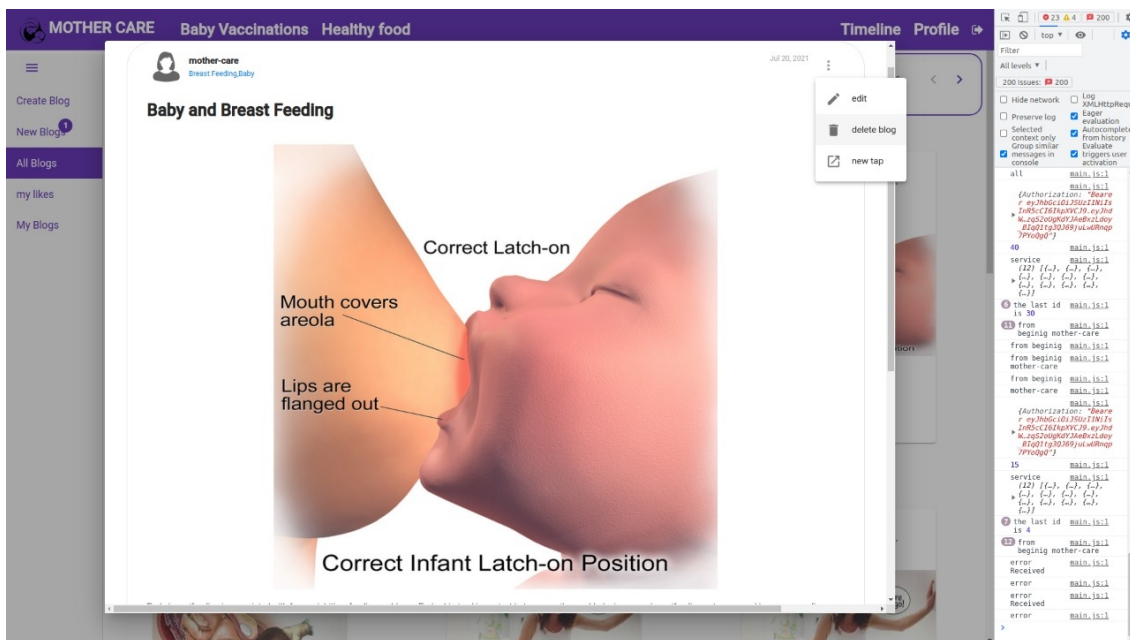
Fig.7 navigate between the blogs

Fig.8 navigate between the blogs

4.2   Mobile App

Main features on the Mobile App

4.2.1   Home Page

4.2.2   Sign up/ Login page

4.2.3   Calendar

4.2.4   Awareness Blogs

- Nutrition

- Vaccination

- Exercise

- Covid-19

- Breast Feeding

- Delivery and Labor

4.2.5   Baby Monitoring

4.2.6   Tracking Baby Monitor (Alarm System)

Fig.9 User profile

Fig.10 User Profile

33.8KB/s

COVID-19

What is COVID-19	>
COVID-19 signs	>
How to deal with COVID-19	>
Masks	>
Medical Instructions	>
Quarantine Instructions	>
Hot Line	>

Timeline   Health   Resources   Profile
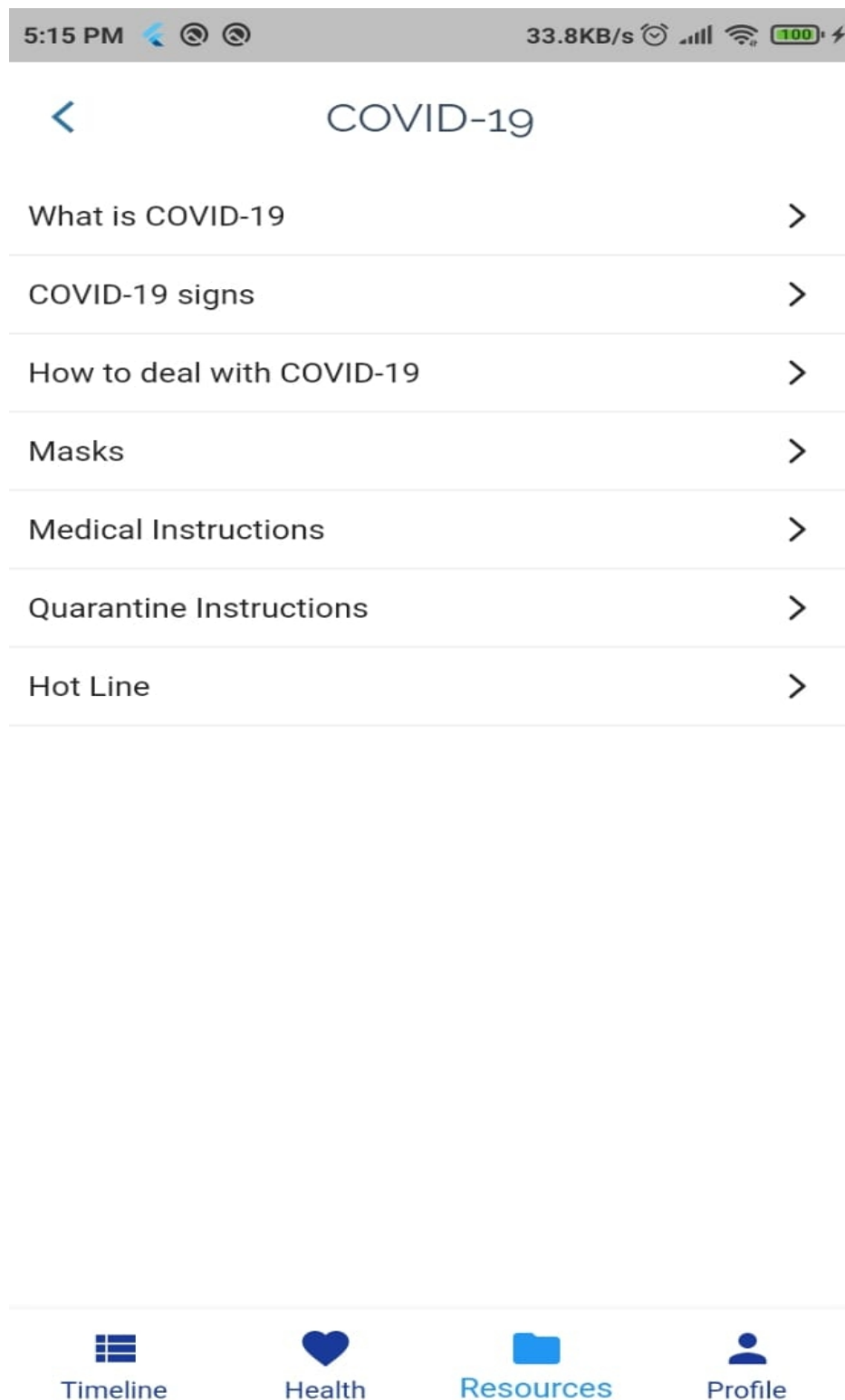
Fig.11 awareness blogs about Covid-19
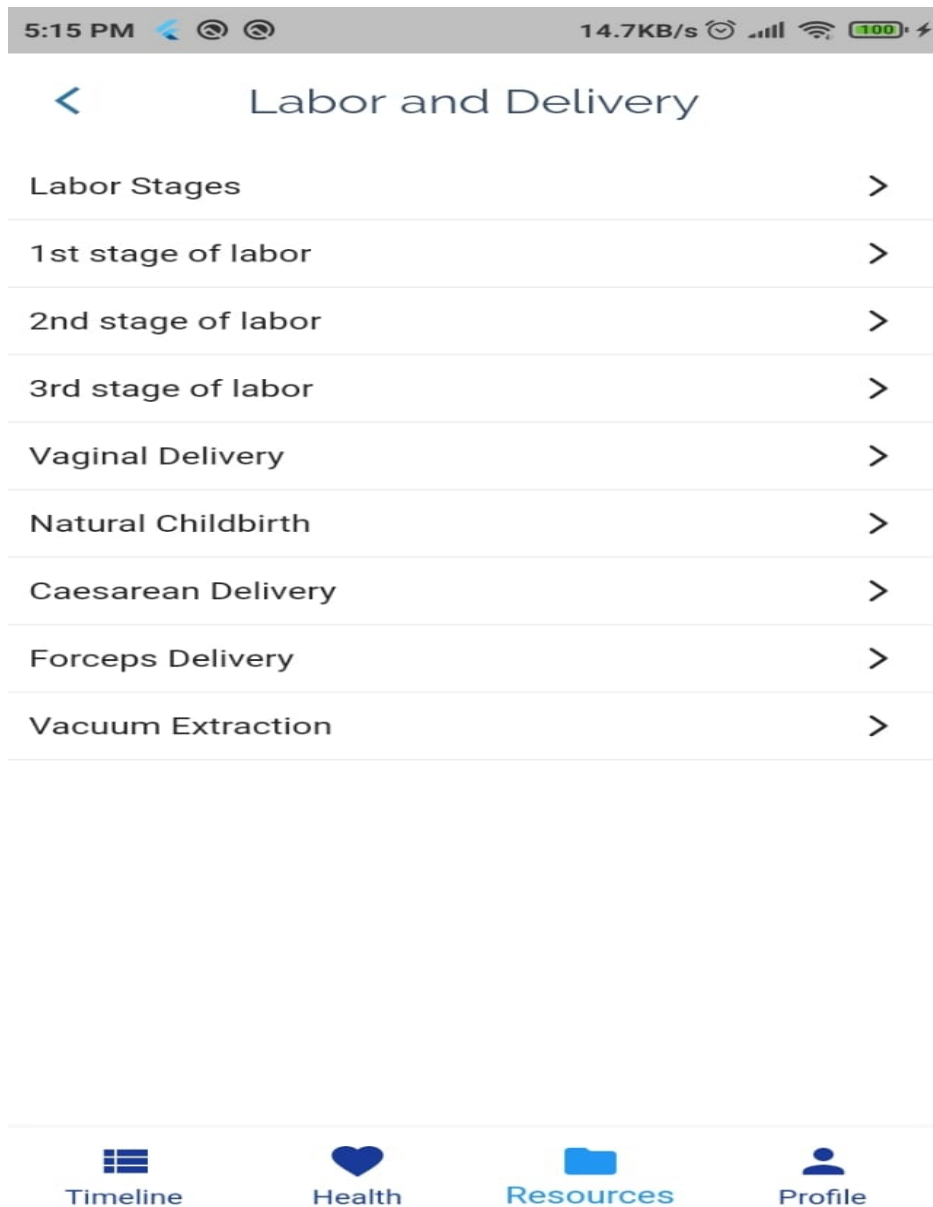
Fig.12 labor and delivery awareness

Vaccination tables

Fig.13 baby vaccination tables

Fig.13 Baby Monitoring 1
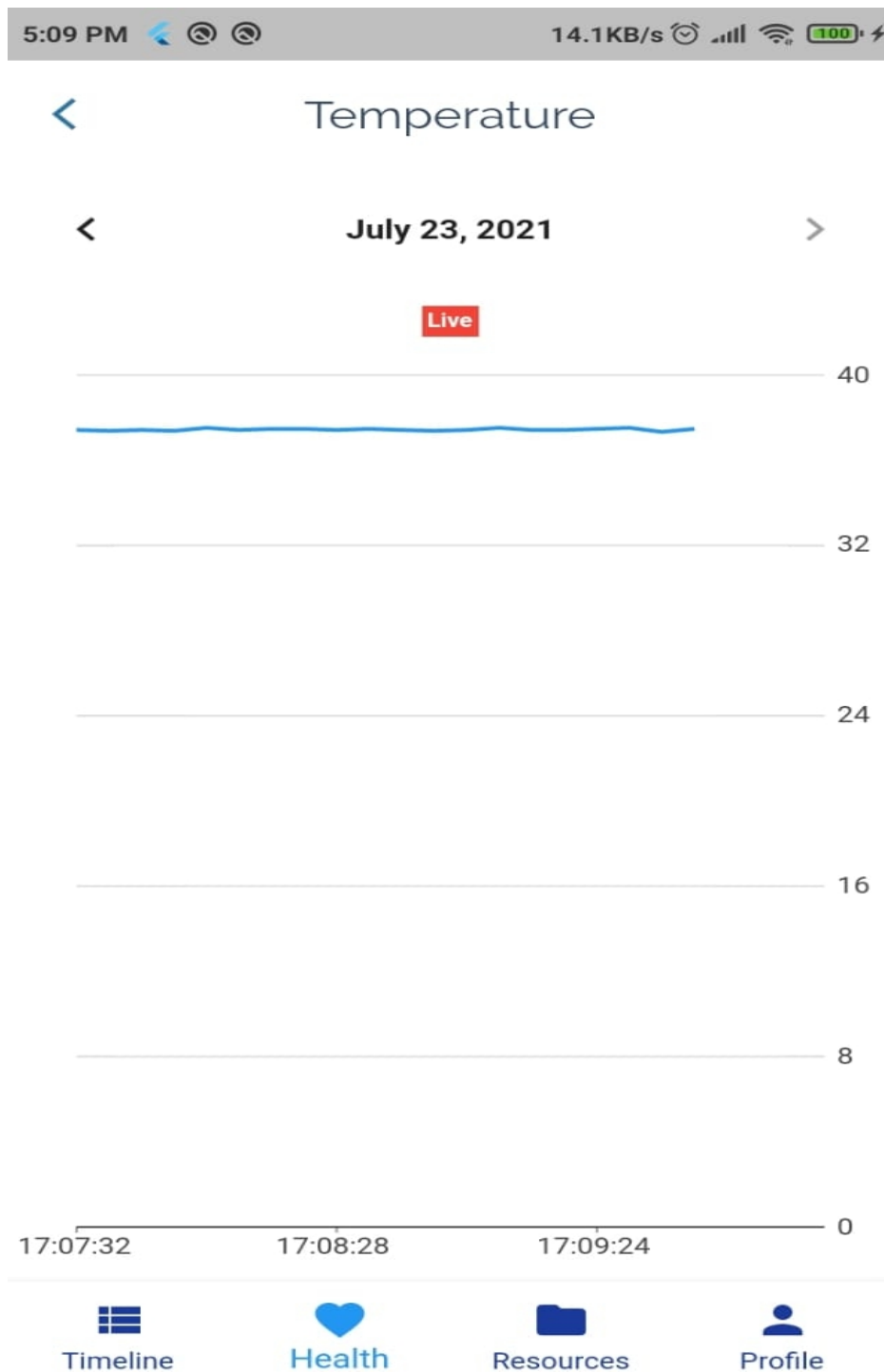
Fig.14 Baby monitoring 2
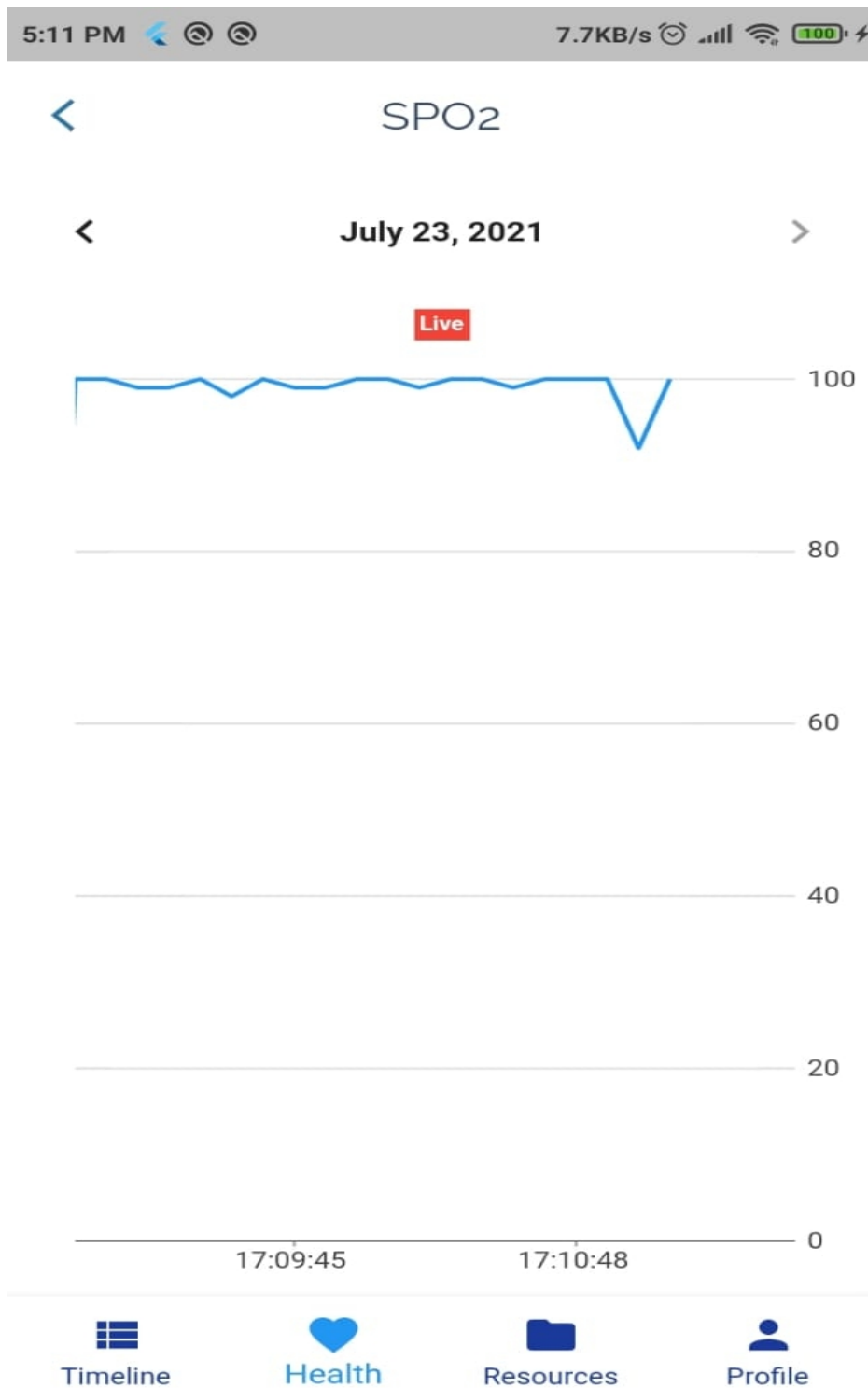
Fig.15 Baby Monitoring 3

Fig.16 Baby Monitoring 4

Fig.17 Baby Monitoring

4.3 IoT kit

We developed a prototype for the kit and currently, we are streaming the following measurement from the kit

4.3.1 Baby Temperature

4.3.2 Baby Position

4.3.3 Heart Rate and SPO2

4.3.4 Room Temperature

Conclusions and future work

 In conclusion, the current fragmentation in the health system needs to be examined and market failures in service delivery, quality and safety, and prevention. public health addressed if Egypt must achieve further gains in maternal and child health in Egypt. Mother-child healthcare it's one of the most important topics that we have to pay attention for it because of improving the well-being of mothers, infants, and children is considered as one of the most important public health goals for the any country. Their well-being determines the health of the next generation and can help predict future public health challenges for communities, families, and the healthcare system. The objectives of the Maternal, Infant, and Child Health topic area address a wide range of conditions, health systems indicators that effect on the health behaviors, wellness, and quality of life of families, women, and children.

The risk of maternal and infant mortality and pregnancy-related complications can be reduced by early identification and treatment of developmental delays and disabilities and other health conditions among infants can prevent death or disability and enable children to reach their full potential through tracking their vital signals with our IoT kit, in addition to publish awareness among females to be more aware and able to take care of her health and her child too.

Future Work

1. **IoT Kit**

   - Integrated GSM module with the kit for sending SMS for each mother as a alarm system.

   - Measuring Respiration Rate using the suitable module.

   - Measuring Sleeping pattern.

   - Interfacing Bluetooth to get network login data for each user.

   - Live Streaming using camera and Computer vision model to detect baby up normal position.

2. **Website**

   - Developing Counseling System through adding doctors on the website.

   - Adding Hospitals on the website to offer labor and follow-up packages.

- Adding new portal for incubators to manage the IoT kits through the Website.

- Indoor localization inside the incubators.

3. Mobile App

- Translate awareness content to Arabic.

- Include voice messages.

- Developing Counseling System through adding doctors on the website.

- Adding new portal for incubators to manage the IoT kits through the Website.

- Indoor localization inside the incubators.

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