# IoT Based Safety Gadget for Child Safety Monitoring & Notification

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## 1. INTRODUCTION

### 1.1 Project Overview

The internet of things (IoT) refers to the set of devices and system that stay interconnected with real-world sensor and to the internet. During years' Child safety is under threat and it is very important to provide a technology-based solution which will help them under panic situations and monitor them using a smart gadget.The proposed system is equipped with GSM and GPS modules for sending and receiving call and SMS between safety gadget and parental phone, the proposed system also consists of Wi-Fi module used to implement IoT and send all the monitoring parameters to the cloud for android app monitoring on parental phone. Android application can be used to track the current location of safety gadget using its location coordinates on parental phone android app and also via SMS request from parent phone to safety gadget. Panic alert system is used during panic situations and automatic SMS alert and phone call is triggered from safety gadget to the parental phone seeking for help and also monitored for plug and unplug from hand, as soon the gadget is unplugged from hand a SMS is triggered to parental phone and the alert parameter is also updated to the cloud.

### 1.2 Purpose

Heart-beats, temperature is monitored and the values are updated to cloud continuously for parent app monitoring. Boundary monitoring system is implemented on safety gadget with the help of BEACON technology, as soon as the safety gadget moves far away from the binding gadget an alert is provided to parent on binding gadget. the system is used to monitor the health parameters and also used for location tracking during necessary situations in safety concern.

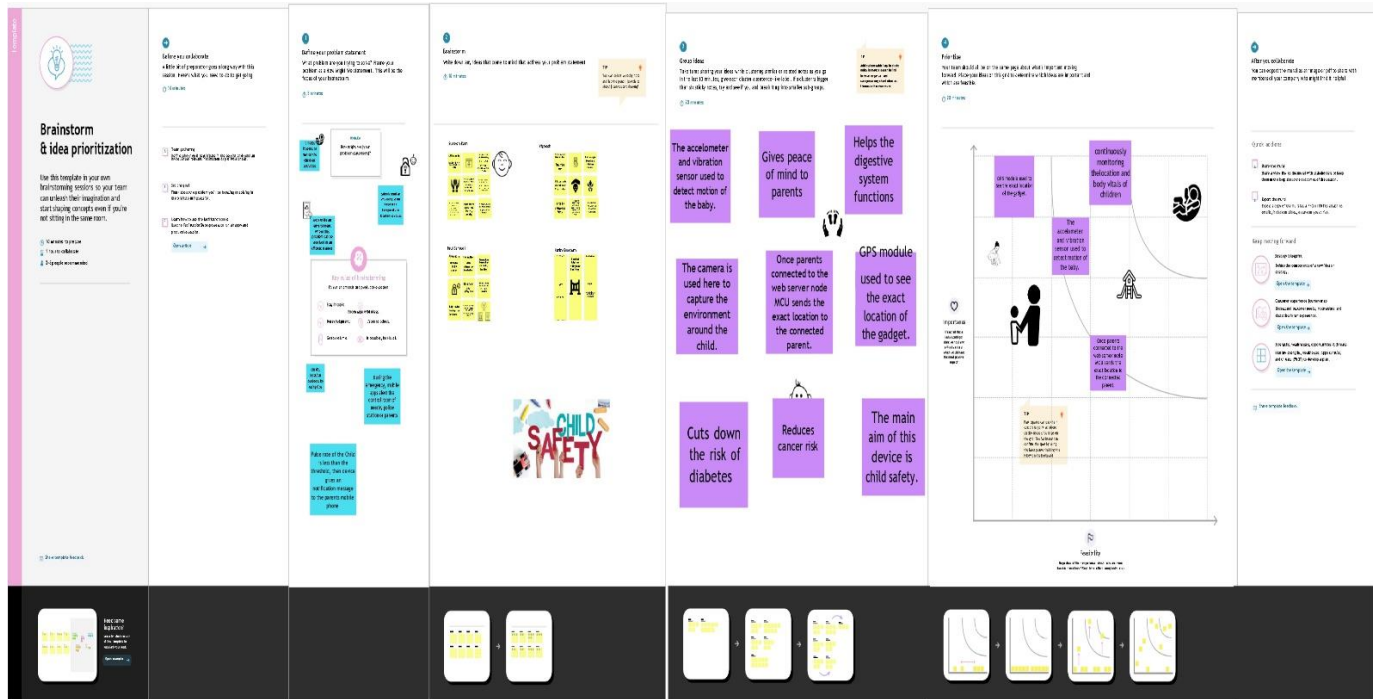## 2. LITERATURE SURVEY

### 2.2 References

[1] Authors: M Nandini Priyanka, S Murugan, K. N. H. Srinivas, T. D. S. Sarveswararao, E. Kusuma Kumari. Title: Smart IoT Device for Child Safety and Tracking. Published in: 2019 IEEE. The system is developed using Link-It ONE board programmed in embedded C and interfaced with temperature, heartbeat, touch sensors and also GPS, GSM & digital camera modules. The novelty of the work is that the system automatically alerts the parent/caretaker by sending SMS, when immediate attention is required for the child during emergency. Merits: The parameters such as touch, temperature & heartbeat of the child are used for parametric analysis and results are plotted for the same. Demerits: To implement the IoT device which ensures the complete solution for child safety problems. [2] Authors: Akash Moodbidri, Hamid Shahnasser Title: Child safety wearable device. Published in: 2017 IEEE. The purpose of this device is to help the parents to locate their children with ease. At the moment there are many wearable's in the market which helps to track the daily activity of children and also helps to find the child using Wi-Fi and Bluetooth services present on the device. Merits: This wearable over other wearable is that it can be used in any phone and it is not necessary that an expensive smartphone is required and doesn't want to be very tech savvy individual to operate. Demerits: As, this device's battery gives short life-time. High power efficient model will have to be used which can be capable of giving the battery life for a longer time.[3] Authors: Aditi Gupta, Vibhor Harit. Published in: 2016 IEEE. Title: Child Safety & Tracking Management System by using GPS. This paper proposed a model for child safety through smart phones that provides the option to track the location of their children as well as in case of emergency children is able to send a quick message and its current location via Short Message services. Merits: The advantages of smart phones which offers rich features like Google maps, GPS, SMS etc. Demerits: This system is unable to sense human behavior of child.[4] Authors: Dheeraj Sunehera, Pottabhatini Laxmi Priya. Title: Children Location Monitoring on Google Maps Using GPS and GSM. Published in: 2016 IEEE. This paper provides an Android based solution for the parents to track their children in real time. Different devices are connected with a single device through channels of internet. The concerned device is connected to server via internet. The device can be used by parents to track their children in real time or for women safety. The proposed solution takes the location services provided by GSM module. It allows the parents to get their child's current-location via SMS. Merits: A child tracking system using android terminal and hoc networks. Demerits: This device cannot be used in rural areas.

### 2.3 Problem Statement Definition

Create a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love. A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also

be able to empathize with your customers, which helps you better understand how they perceive your product or service.

## 3. IDEATION & PROPOSED SOLUTION

### 3.1 Empathy Map Canvas



EMPATHY MAP: IOT Based Safety Gadget For Child safety monitoring and notification(persona &context)

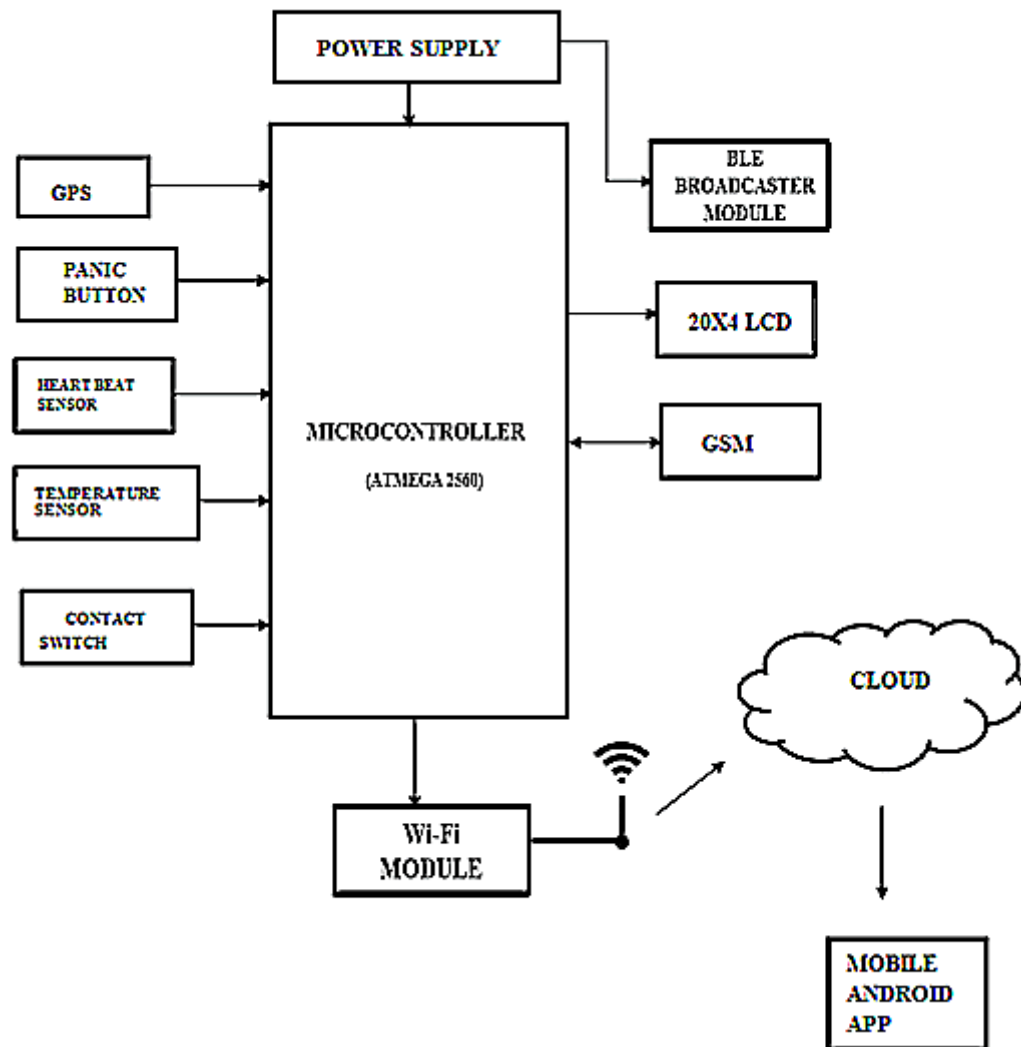### 3.2 Ideation & Brainstorming

### 3.3 Proposed Solution

The block diagram of the proposed child safety device. It consists of inbuilt Wi-Fi, GSM, GPS and Bluetooth modules. The link it one board is similar to the Arduino board and it is termed as all-in-one prototyping board for safety and IoT devices. The link it one is a robust development board for the hardware and also used for industrial applications. Different components such as temperature sensor, heartbeat sensor, panic button, contact switch are connected to the link it ONE board along with built in GSM, GPS modules. Safety gadget consists of BEACON and BLE packet is transmitted through it, this packet is received by binding gadget which has BLE receiver module, the packet usually contains information such as identification number, signal strength etc. Temperature is one of the most commonly measured variables. For measuring body temperature of the child DS18B20 temperature sensor is used. The heartbeat sensor is used in the proposed system for measuring the pulse rate. There is a heartbeat/pulse sensor which is combined to simple optical heart rate sensor with amplification and nullification circuitry making it is fast and easy to get reliable pulse reading. The GSM/GPRS block is activated with a SIM card on the board. They mainly differ based on bandwidth and RF carrier frequency.

GSM network consists of mobile station, base station subsystem network and operation subsystem. The GPS module is provided for identifying the location of the child. GPS module receives the signals from satellites. The latitude and longitude of the location can be identified by the GPS module. The device sends the monitored parameters data such as temperature and pulse rate to cloud. If any abnormalities occurs in temperature or pulse rate readings, a SMS and call triggers to the parent/caretaker mobile phone immediately and also updated to the mobile app only for the registries mobile no. We can use mobile application, cloud and database as the back end of storing and retrieving information and also a device for monitoring.

Software Specification The Arduino Software (IDE) which is an open-source and makes it easy to write the code as well as to upload in to the board. It runs on the Linux, Mac, IOS and

Windows. The programs are written in Java, based on the Processing and other open-source software. This software makes the interfacing with Arduino-Uno much more reliable. The primary reason for using the GS shield as the mode of communication over Wi-Fi and Bluetooth was that this gadget was aimed at being accessible to any smartphone user.

## 3.4 Problem solution fit

| 1. CUSTOMER SEGMENT(S) — CS | 6. CUSTOMER LIMITATIONS EG. BUDGET, DEVICES — CL | 5. AVAILABLE SOLUTIONS PLUSES & MINUSES — AS |
|---|---|---|
| Parents/Guardians of the children who seek safety for their children when they are | Connectivity issues which play a major role in a child tracking system may not be fully reliable in a cheaper system and so customers are forced to choose | Of course, there are readily available options on the market such as child GPS tracking systems, wearable devices, etc. However, one of the challenges that customers face is the expense and |

| 2. PROBLEMS / PAINS + ITS FREQUENCY — PR | 9. PROBLEM ROOT / CAUSE — RC | 7. BEHAVIOR + ITS INTENSITY — BE |
|---|---|---|
| Improving the proposed solutions operational state so that it can handle any problem at any time without fail so that child safety may be highly assured. to guarantee the parents that the monitoring of their kids will never stop. | The problem started with just a few irrational people who have nothing to do with kids and are only interested in things like money and child abuse (which mostly affects young girls) | The suggested solution always strives to make the device operate effectively so that it won't encounter any new limitations. |

| 3. TRIGGERS TO ACT — TR | 10. YOUR SOLUTION — SL | 8. CHANNELS of BEHAVIOR — CH |
|---|---|---|
| Customers are influenced by the positive reviews of other working parents, they are more likely to try it themselves to improve their child | Our team has been working effectively to come up with a solution to fix every problem that the current systems have. We are in high demand to guarantee the developing system's effective functionality in such a way that it | Promoting through social media. With the help of social media entrepreneurs and clients will receive<br><br>OFFLINE the most effective<br>Through newspaper advertisements. |
| **4. EMOTIONS** BEFORE / AFTER — EM<br>Parents are frustrated since they are unsure if their children are safe before utilizing the item. They may feel free to concentrate on their work once they start to use the designed solution, and they will also be able to easily | | |

# 4. REQUIREMENT ANALYSIS

## 4.1 Functional requirement

Following are the functional requirements of the proposed solution.

| FR No. | Functional Requirement (Epic) | Sub Requirement (Story / Sub-Task) |
|---|---|---|
| FR-1 | User Registration | ✓ Registration through Gmail<br>✓ Registration through phone number |
| FR-2 | User Confirmation | ✓ Confirmation via Email<br>✓ Confirmation via OTP |
| FR-3 | App installation | ✓ Installation through link<br>✓ Installation through play store |
| FR-4 | Settings geofence | ✓ Setting by user to find child location |
| FR-5 | Detecting child location | ✓ Detecting location via app<br>✓ Detecting location via SMS |
| FR-6 | User Interface | ✓ User Login Form.<br>✓ Admin Login Form. |
| FR-7 | Database | ✓ Stored in cloud for seamless connectivity.<br>✓ Parents and kids link with the distance and the location values obtained from the mobile devices are stored here.<br>✓ The values include parent id,kid id,distance,longitude,latitude etc. |

| FR No. | Functional Requirement | Sub Requirement |
|--------|------------------------|-----------------|
| FR-8 | Server | ✓ It connects the database and the front end application.<br>✓ The backend server has been implemented to run as a service and is deployed in an IBM cloud instance.<br>✓ The backend server has been implemented to run as a service and is deployed in an IBM cloud instance. |
| FR-9 | GPS tracking | ✓ The system is implemented with a GPS module, which acquires the location information of the user and stores it to the database. |
| FR-10 | API | ✓ The value collected is sent to the database using an API. |
| FR-11 | React JS | ✓ We are using react js as front end for our project.<br>✓ Node JS for the back end we are using node js. |
| FR-12 | GPS modules | ✓ It receives data directly from satellites. |
| FR-13 | Battery Life | ✓ If the child or parent forgets to charge the device for a whole day then also the device will work. That's why we aim to make this device last the whole day with one charge.<br>✓ It should be long-lasting. |
| FR-14 | Location History | ✓ The location history will help to track the child's activity so that the aren't will be updated. Location history will be there for 30 days.<br>✓ For example if the child gets missing with the help of location history the aren't can track down their child's activity and also can find their child. |

## 4.2 Non-Functional requirements

Following are the non-functional requirements of the proposed solution.

| FR No. | Non-functional Requirements | Description |
|--------|------------------------------|-------------|
| NFR-1 | Usability | ✓ Device have GSM can help to inform the parents or relatives about the current situations of the child by deliver the message immediately to save the child. |
| NFR-2 | Security | ✓ Make children parents more assure about their kid's security, we have a feature in our device called Geo-Fence. <br> ✓ Whenever your child crosses that specific area, you will get an instant notification on your phone. |
| NFR-3 | Reliability | ✓ Portable ✓ <br> Easy to use ✓ <br> Flexibility |
| NFR-4 | Performance | ✓ Create a Child tracker which helps the parents with continuously monitoring the child's location. <br> ✓ The notification will be sent according to the child's location to their parents or caretakers. <br> ✓ The entire location data will be stored in the database. |
| NFR-5 | Availability | ✓ Track your child even in a crowd <br> ✓ Get travel details of kids at anytime <br> ✓ Know the current location |
| NFR-6 | Scalability | ✓ Gadget ensures the safety and tracking of the children. <br> ✓ Parents need not worry about their children. |
| NFR-7 | Valuability | ✓ The system should be able to deliver promptly to the financing authority. <br> ✓ In the case of non-profit organizations, the solution should be 'advancing the mission'. |

| FR No. | Non-functional Requirements | Description |
|---|---|---|
| NFR-9 | Dynamicity | ✓ IoT devices may have the capability to adapt dynamically and change based on their conditions. |
| NFR-10 | Desirability | ✓ Navigation should be made easy.<br>✓ The user should be able to search and find the information he needs without much hassle. |

# 5. PROJECT DESIGN

## 5.1 Data Flow Diagrams

**Data Flow Diagrams:**

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

**Data flow diagram :**
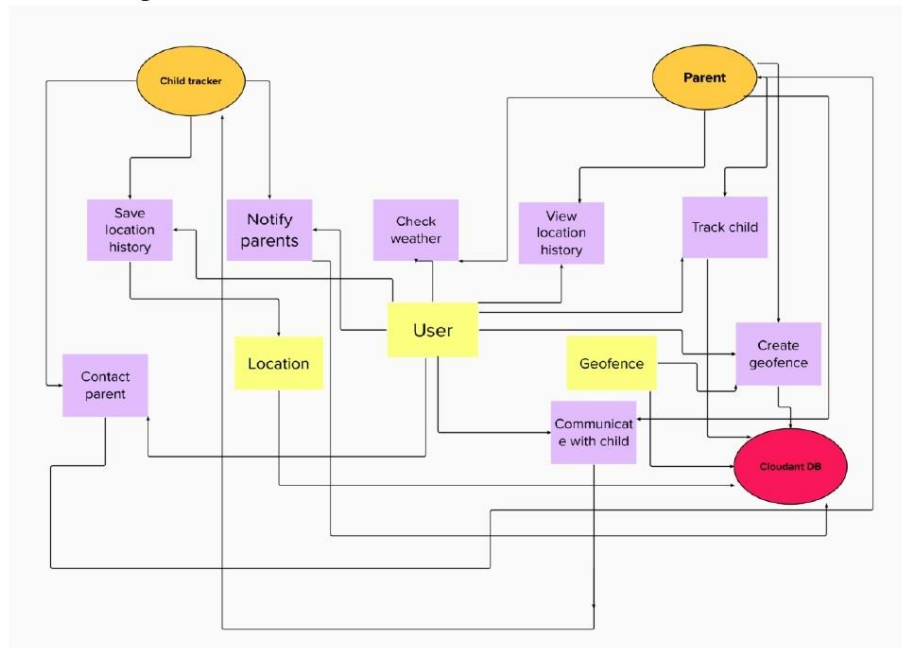
**User Stories**

| User Type | Functional Requirement (Epic) | User Story Number | User Story / Task | Acceptance criteria | Priority | Release |
|---|---|---|---|---|---|---|
| Parent | Registration | USN-1 | As a user, I can register for the application by entering my email, password, and confirming my password. | I can access my account / dashboard | High | Sprint-1 |
| | | USN-2 | As a user, I will receive confirmation email once I have registered for the application | I can receive confirmation email & click confirm | High | Sprint-1 |
| | | USN-3 | As a user, I can register for the application through Gmail | | Medium | Sprint-1 |
| | Login | USN-4 | As a user, I can log into the application by entering email & password | | High | Sprint-1 |
| | Dashboard | USN-5 | As a user , I need to be able to view the functions that I can perform | | High | Sprint-1 |
| Child | Notification | USN-1 | As a user , I should be able to notify my parent in emergency situations | | High | Sprint-2 |
| | Store data | USN-2 | As a user , I need to continuously store my location data into the db. | | Medium | Sprint-2 |
| | Communication | USN-3 | I should be able to communicate with my parents | | Low | Sprint-3 |

## 5.2 Solution and technical architecture:
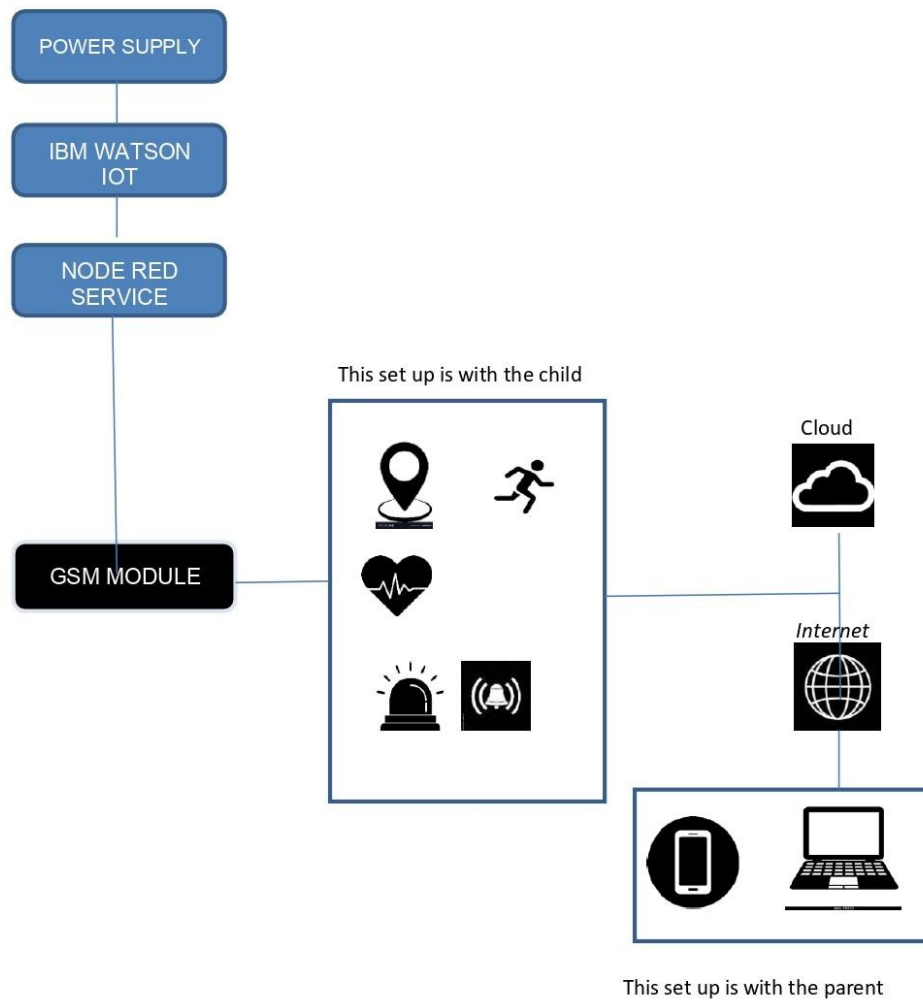
**Solution Architecture:**

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

**Solution Architecture Diagram:**



Essential components of an IoT architecture

This set up is with the child
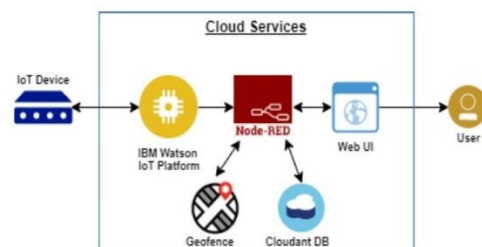
Cloud

Internet

This set up is with the parent
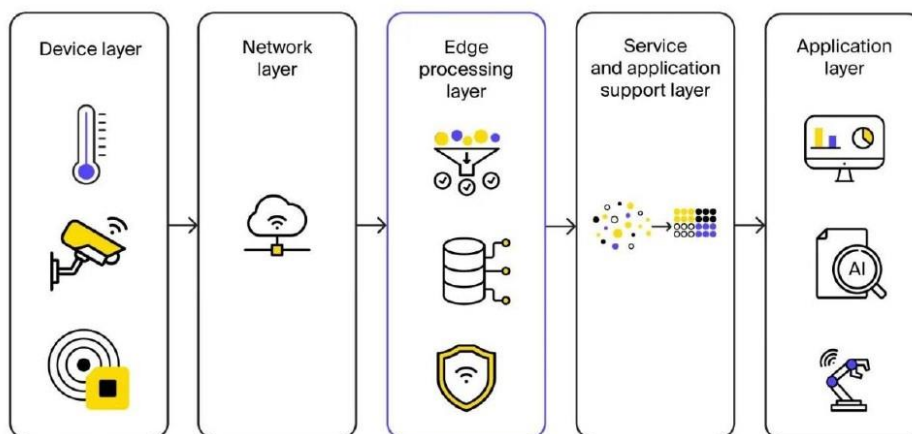
**Technical Architecture:**



**Table-1 : Components & Technologies:**

| S.No | Component | Description | Technology |
|------|-----------|-------------|------------|
| 1. | User Interface | The communication protocol being used in the proposed solution might act as an interface the way like WiFi, Bluetooth and ZigBee | MIT app |

| 2. | Application Logic | The data to be collected and sent to the authenticator's(parent) via GSM providing the GPS coordinates to easily locate access and monitor the child | IBM Watson STT service, python etc |
| 3. | Database | Data to be segregated and secured in the form of relational DBMS | MySQL |
| 4. | Cloud Database | IBM | IBM Cloudant |
| 5. | File Storage | File storage requirements | IBM Block Storage or Other Storage Service or Local Filesystem |
| 6. | External API-1 | To access the children location | GPS location monitoring etc |
| 7. | Infrastructure (Server / Cloud) | Application Deployment on Local System / Cloud Local Server Configuration | Cloud Foundry |

**Table-2: Application Characteristics:**

| S.No | Characteristics | Description | Technology |
| --- | --- | --- | --- |
| 1. | Open-Source Frameworks | The proposed solution being framed in the form an android application providing the end user an easy surveillance of their children (preferably users are parents) | UI/UX design developement |
| 2. | Security Implementations | The developed application should be accessible in the way it can only respond to the comments of the relevant users | Encryptions, IAM Controls. |
| 3. | Scalable Architecture | The app format comes the way easier to handle and operate. | Not yet determined |
| 4. | Availability | The developed solution tends to be available in the market at any time | Not yet determined |
| 5. | Performance | Highly proper and betterment functionalities are to be ensured in the designed solution | Not yet determined |

# 6. PROJECT PLANNING & SCHEDULING

## 6.1 Sprint Planning & Estimation

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|--------|-------------------------------|-------------------|-------------------|--------------|----------|--------------|
| Sprint-1 | Gadget Registration | USN-1 | As a user, I can register for the child safety by entering my email, password, and confirming my password. | 2 | High | 2 |
| Sprint-1 | | USN-2 | As a user, I will receive confirmation email once I have registered for the device. | 1 | High | 1 |
| Sprint-2 | | USN-3 | As a user, I can register for the taking care of child tracking location. | 2 | Low | 2 |
| Sprint-1 | | USN-4 | As a device, we can track them and share the notification the user. | 2 | Medium | 2 |
| Sprint-1 | Login By user | USN-5 | As a user, I can log into the application by entering email & password. And they can track the child if the child is missing through the device. | 1 | High | 1 |
| | Dashboard | | The user can get lots of notification options,GPS tracker,alarm in case of emergency. | 3 | High | 3 |

## 6.2 Sprint Delivery Schedule

| Sprint | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed (as on Planned End Date) | Sprint Release Date (Actual) |
|--------|--------------------|----------|-------------------|---------------------------|-------------------------------------------------|------------------------------|
| Sprint-1 | 20 | 6 Days | 24 Oct 2022 | 29 Oct 2022 | 20 | 29 Oct 2022 |
| Sprint-2 | 20 | 6 Days | 31 Oct 2022 | 05 Nov 2022 | 20 | 05 Nov 2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov 2022 | 12 Nov 2022 | 19 | 12 Nov 2022 |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov 2022 | 20 | 19 Nov 2022 |
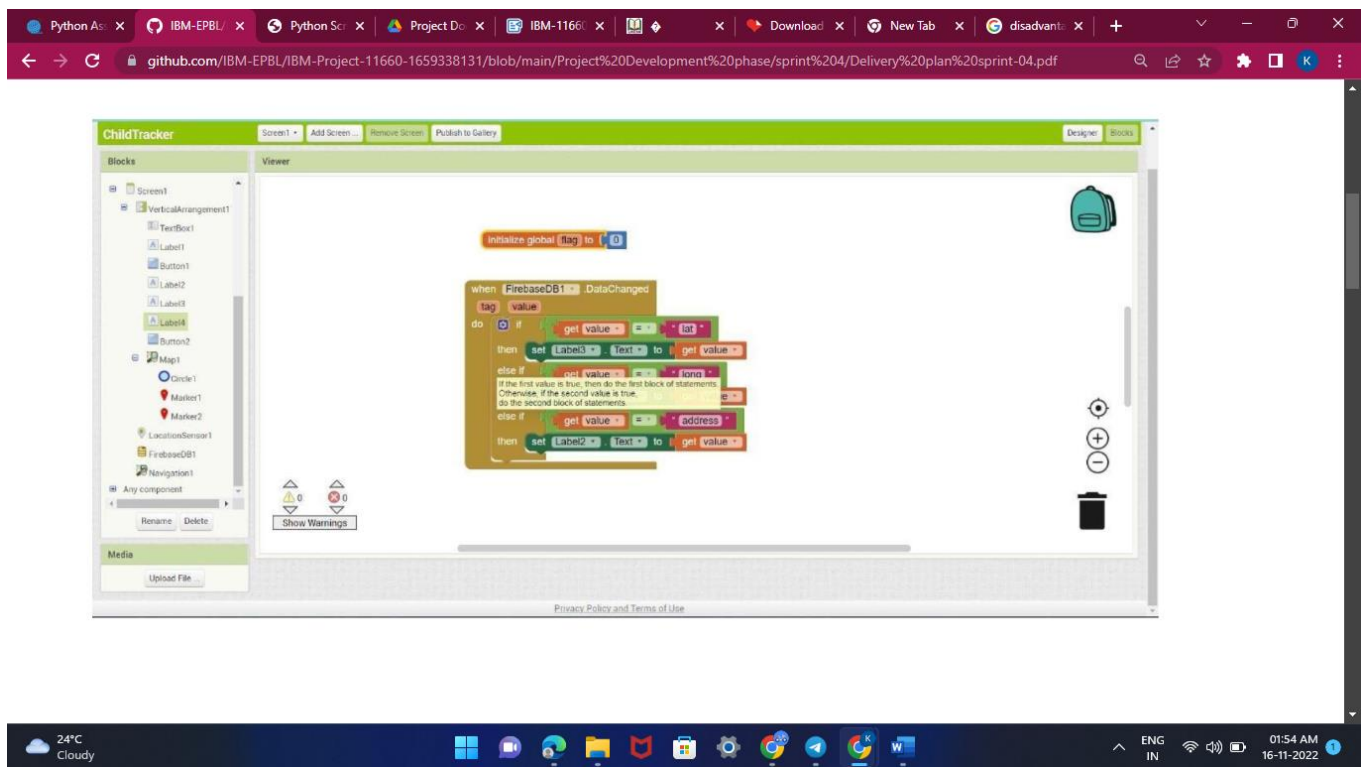
7. **CODING & SOLUTIONING (Explain the features added in the project along with code)**

```
import json
import wiotp.sdk.device
import time

myconfig = {
    "idebtity": {
        "orgId": "hj5fmy",
        "typeId": "NodeMCU",
        "deviceId": "12345678"
    },
    "auth": {
        "token": "12345678"
    }
```

```
}
client = wiotp.sdk.device.Deviceclient(config=myconfig, logHandlers=None)
client.connect()
while True:
        name= "Smartbridge"
#in area location
#latitude=17.4225176
#longitude=78.5458842
#out area location
latitude=17.4219272
longitude=78.5488783
myData={'name': name, 'lat': latitude,'lon': longitude}
client.publishEvent(eventId="status",msgformat="json",
data=mydata, qos=0, onpublish=None)
print("Data published to IBM IOT platform :",myData)
time.sleep(5)
client.disconnect()
```
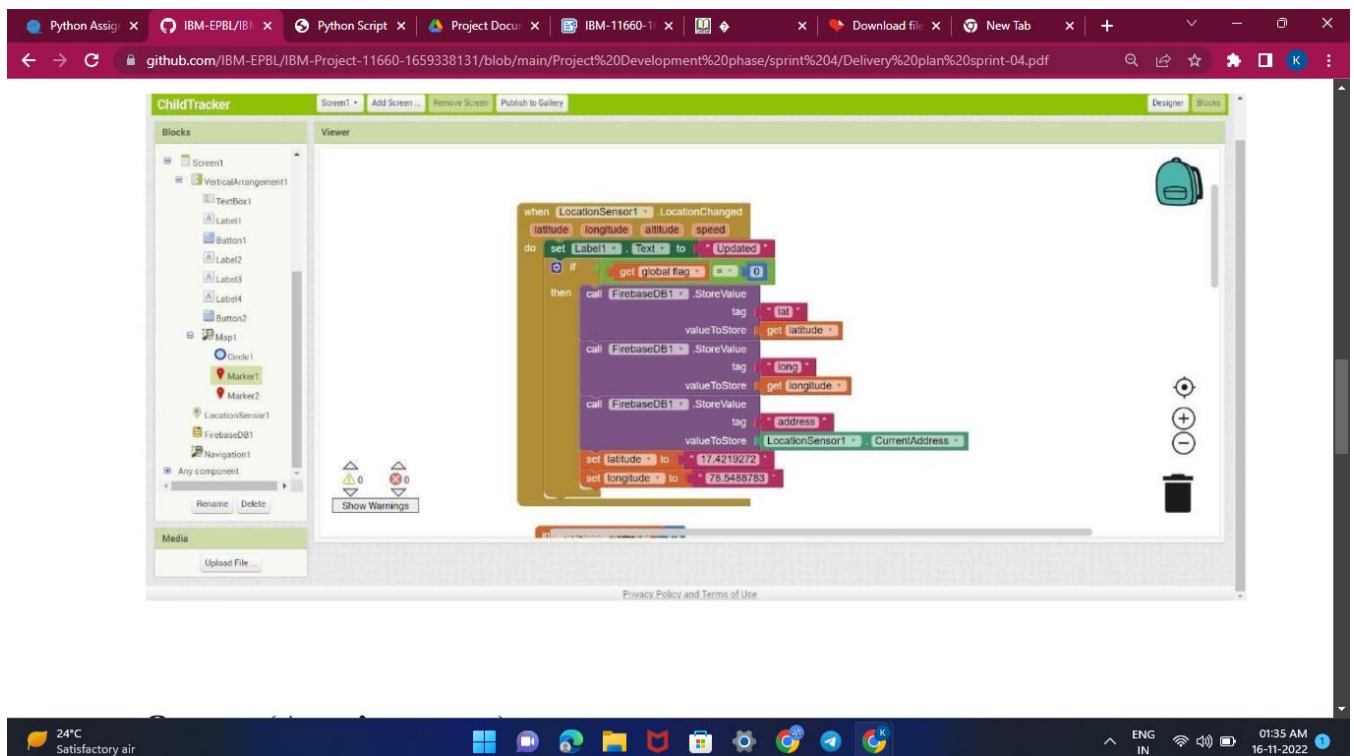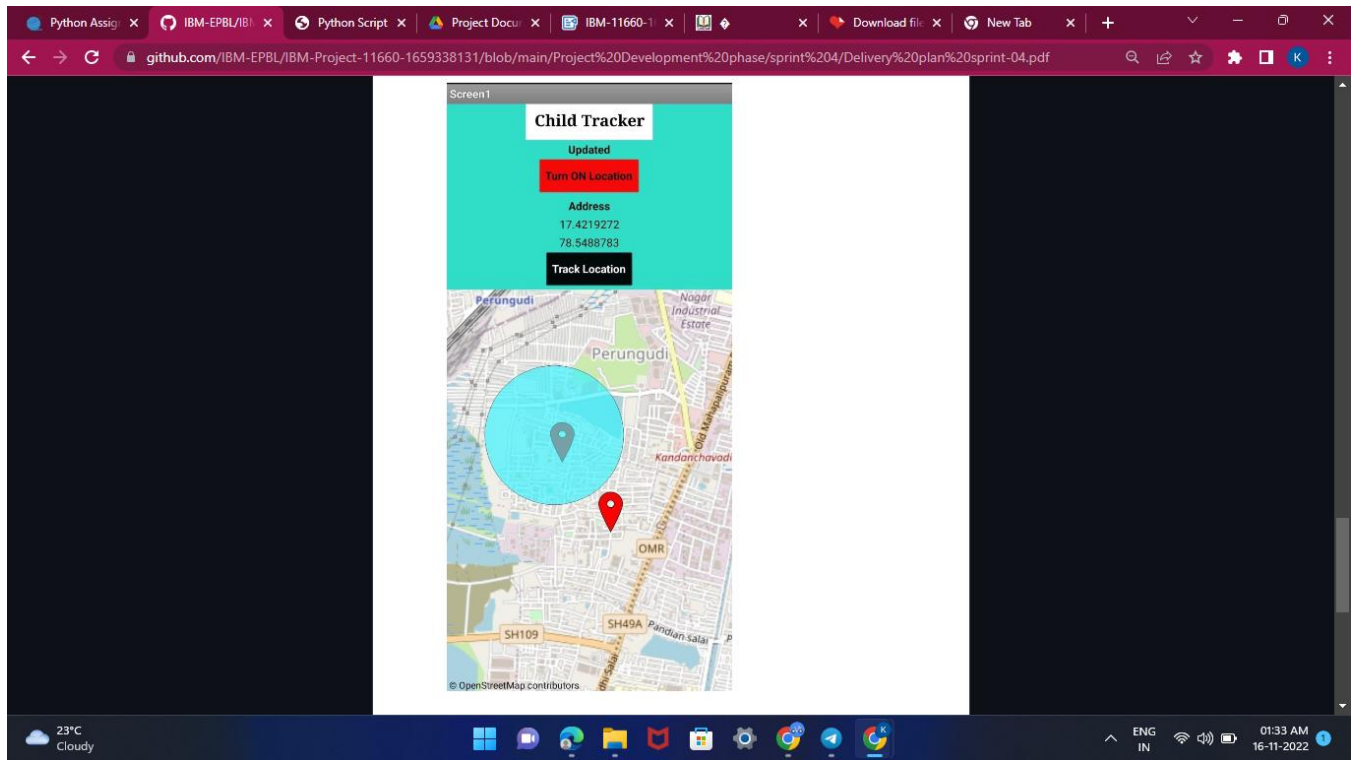
## 8. **TESTING**

8.1 Test Cases
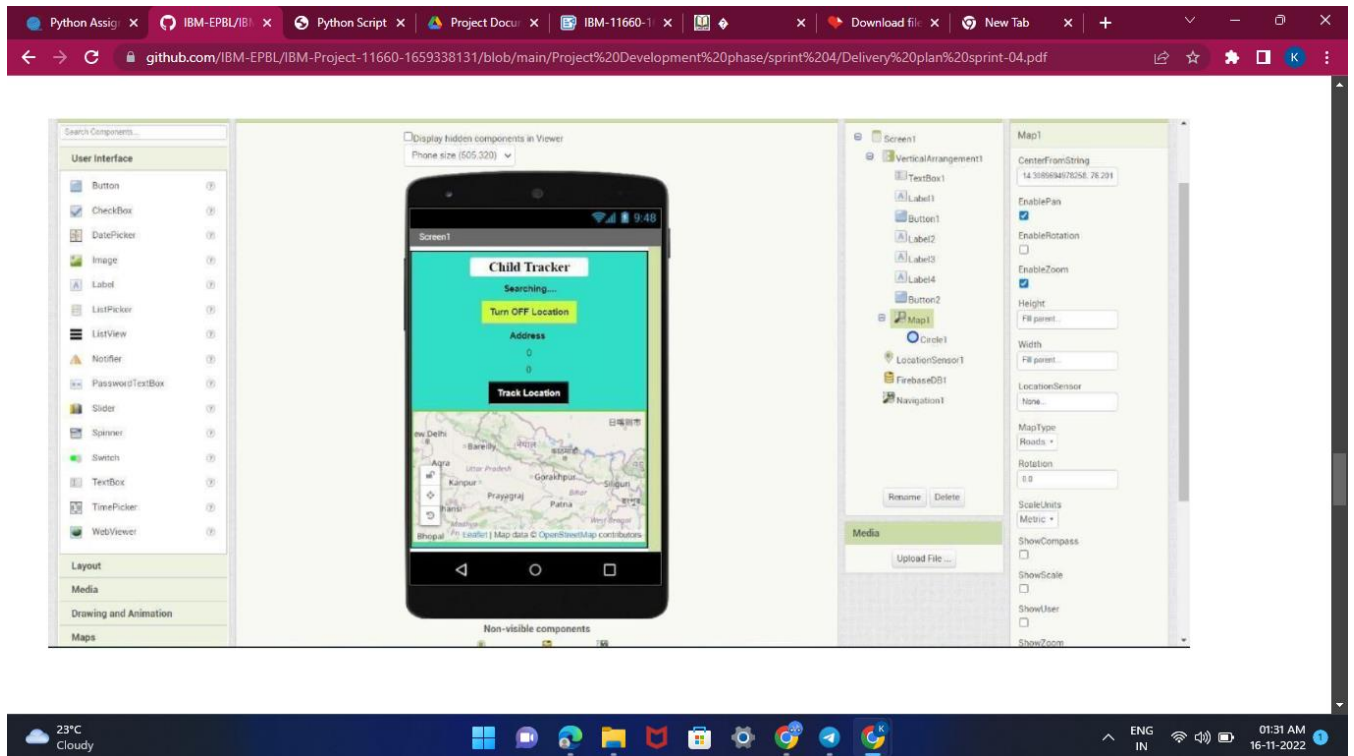
8.2 User Acceptance Testing

## 9. RESULTS

## 10. ADVANTAGES & DISADVANTAGES

It assists parents to monitor their children remotely. In case situations happen, notifications will be sent to parents so that actions can be taken. Through this, child safety can be ensured and crime rate will be reduced.

### Disadvantage:

This device cannot be used in rural areas. Figure 1 shows the block diagram of the proposed child safety device. It consists of inbuilt Wi-Fi, GSM, GPS and Bluetooth modules.

## 11. CONCLUSION

This research demonstrates Smart IoT device for child safety and tracking, to help the parents to locate and monitor their children. If any abnormal readings are detected by the sensor, then an SMS and phone call is triggered to the parents mobile. Also, updated to the parental app through the cloud. The system is equipped with GSM and GPS modules for sending and receiving call, SMS between safety gadget and parental phone. The system also consists of Wi-Fi module used to implement IoT and send all the monitored parameters to the cloud for android app monitoring on parental phone. Panic alert system is used during panic situations alerts are sent to the parental phone, seeking for help also the alert parameters are updated to the cloud. Boundary monitoring system is implemented on safety gadget with the help of BEACON technology, as soon as the safety gadget moves far away from the BLE listener gadget an alert is provided to itself.

## Source Code

```python
from http import client
import json
import wiotp.sdk.device
import time
myConfig = {
    "identify":{
        "orgId":"hj5fmy",
        "typeId":"NodeMCU",
        "deviceId":"12345678"
    },
    "auth":{
        "token":"12345678"
    }
}
client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()
while True:
    name= "Smartbridge"
    #in area location
    #latitude=17.4225176
    #longitude 78.5458842
    #out area location
    latitude=17.4219272
    longitude=78.5488783
    myData={'name': name, 'lat': latitude, 'lon': longitude}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos-0,
onPublish=None)
    print("Data published to IBM IOT platfrom: ",myData)
    time.sleep(5)

client.disconnect().
```

- Python script sending requests to IBM Cloud

GitHub & Project Demo Link

https://github.com/IBM-EPBL/IBM-Project-8401-1658918101