Harmful Child Activity Detection and Assistance

2021-115

Overall Research Problem

- Everyone in this generation lives with the pressure of engaging in numerous activities within a 24-hour time frame.
- A working mom is an obvious victim of this situation sandwiched between the two roles as a mom and as a wife.
- Mothers are forced to balance these two roles along with office work when corporates changed their rosters to work from home due to the pandemic situation .
- Babysitters might look like a quick solution but then again leaves us with the same question, whether it is safe enough?
- Having a babysitter is also not the most popular solution when aligning to different cultures.

Overall Research Solution

- A real-time surveillance camera system is proposed to capture harmful child activities right at point.
- Parent/guardian will be alert, or a sound warning will be given to the child as soon as a harmful activity is detected.
- The proposed solution is capable of capturing
    I. Child climbing to a dangerous position or leaving the safe zone boundary of the room
    II. Presence of sharp objects or hot liquid containers in close proximity to the child
    III. An unauthorized person entering to the room and possible kidnap
    IV. Child is operating electrical extension cords or touching plug points in the room

Overall Research Objectives

Main Objective:

- Capturing harmful events (Child hazardous events) and objects (dangerous objects) effectively and accurately and taking prompt responsive actions to avoid the danger.

Objective 1:

- Capture safety zone boundary breach and spot unsafe heights from the current position.

Objective 2:

- Identify injurious sharp objects and hot liquid containers within reach and detect its usage closer to the body.

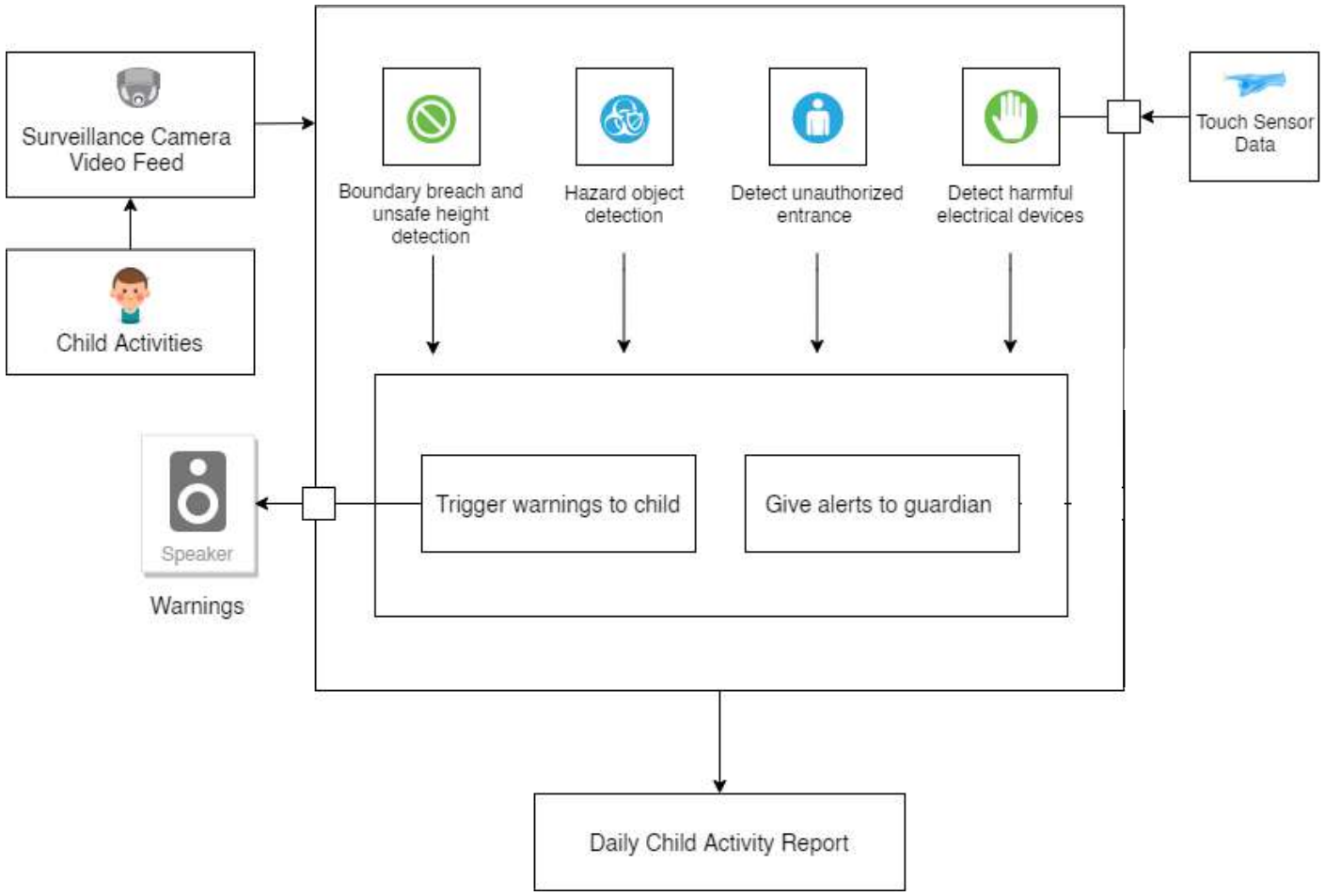
Objective 3:

- Identify unauthorized entrance and take immediate actions to stop possible kidnap.

Objective 4:

- Recognize harmful electric devices in the area and notify when such device is in contact.

Overall System Overview Diagram



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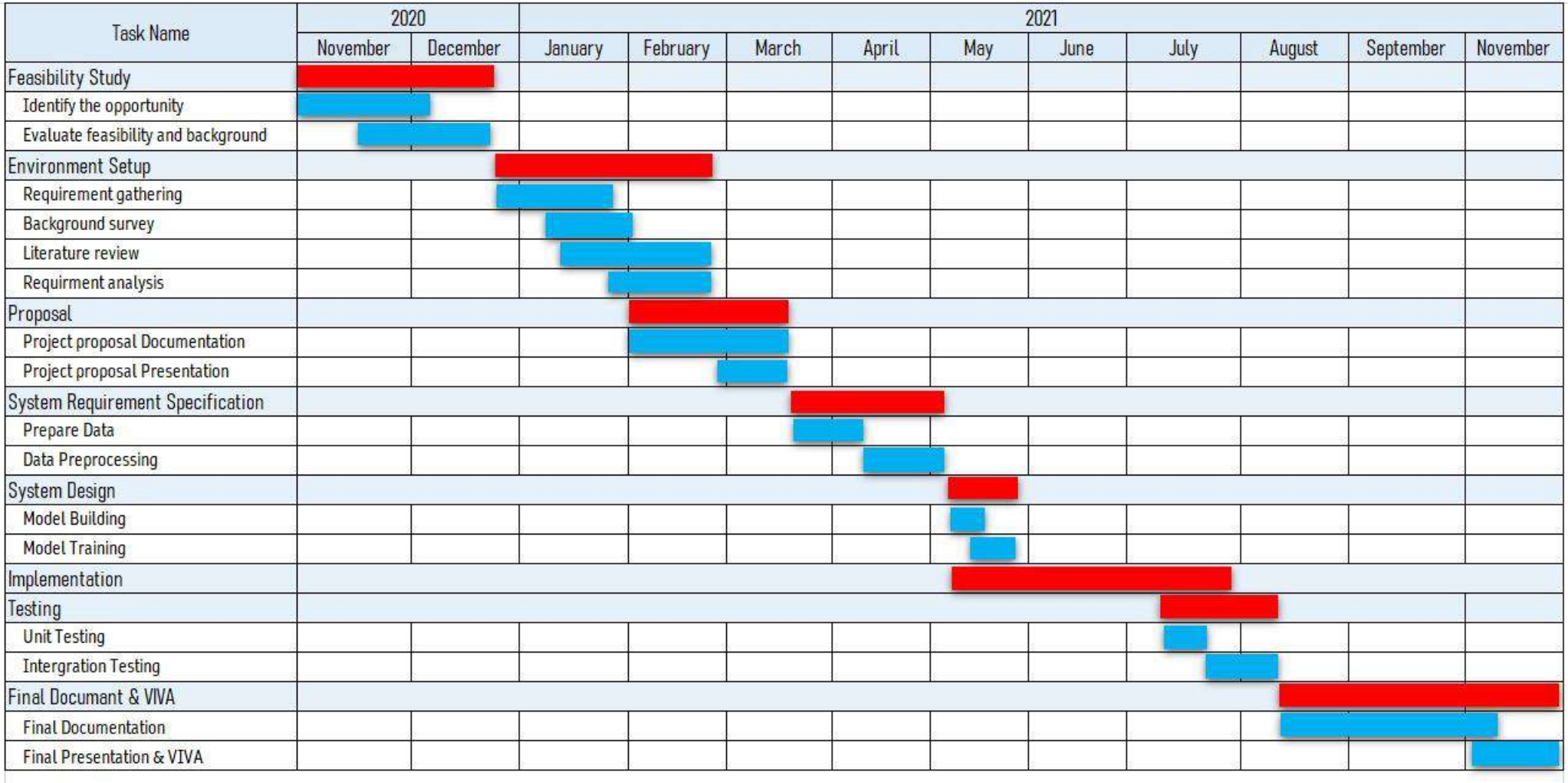
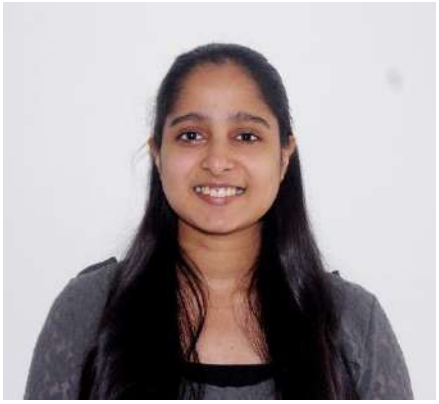

Task Name
2020
November
December
2021
January
February
March
April
May
June
July
August
September
November
Feasibility Study
Identify the opportunity
Evaluate feasibility and background
Environment Setup
Requirement gathering
Background survey
Literature review
Requirment analysis
Proposal
Project proposal Documentation
Project proposal Presentation
System Requirement Specification
Prepare Data
Data Preprocessing
System Design
Model Building
Model Training
Implementation
Testing
Unit Testing
Intergration Testing
Final Documant & VIVA
Final Documentation
Final Presentation & VIVA

Commercialization

- In a society where families with both parents working has become a common norm, chi ldren has left to grow up by themselves.
- Children between the age 1 year and 5 year is the most crucial period where a child need a lot of parental attention.
- Thereby, AICare has the potential to be the latest trend in childcare in the coming decade.
- Being able to give real time protection assistance to a child when parents are attending to work increase the average working time of an employee. Being able to work from home reduces the number of leaves an employee might take.
- We anticipate that AICare is going to be a top solution companies will invest on providing for their employees because of the high return of investment AICare provides.



IT18110708 | KODIKARA K.A.O.V

Data Science

Background

- Kidnap detection is a popular research aspect and has many applications in areas such as
    - Area localizing [1]
    - Bluetooth tracking [2][3]
    - Pose detection[5]
    - Frame based event detection [6]
- All these approaches are based on the person who is kidnapped.
- And these applications does not provide a proper implementation in detecting child abduction/kidnap

Background

- Child kidnap is different and more dangerous than a common adult kidnap.[7]
  - Children are very open and trusting
  - Children tend to believe and listen to adults
  - Children get easily fooled by petty means of kind actions
- A child can be kidnapped without using force and thereby will not be captured by mere action, event and pose detection algorithms.
- Here I propose a methodology of real-time child kidnap detection and prevention assistance based on kidnapper characteristics mentioned follows,
  - Suspicious face covering
  - Quick actions/speed movements
  - Posses harmful objects

Research Gap

Research	Detect child kidnaps	Consider characteristics of a kidnapper for the research	Prevent kidnap before happening	Give alert or notification on detecting a kidnap
Research A [1]	NO	NO	NO	YES
Research B [4]	NO	YES	NO	YES
Research C [5]	NO	NO	NO	YES
Research C [6]	NO	NO	NO	YES
AICare	YES	YES	YES	YES

Research Question

- More than 900,000 kids are reported kidnapped/missing every year around the world.[8]
- A significant number of these kidnaps happens at home or when residing with a responsible adult.
- In the present society where both parents working has become a common culture.
- The pandemic situation has forced parents to adjust themselves to work from home arrangements.
- In such circumstances giving fulltime attention to their young child has become a difficult task.

Objectives

- Main Objective

- To ensure that children in the early development stages are safe from kidnapping.

- This safety is achieved by an intelligent surveillance system that is placed in the area where the child is present.

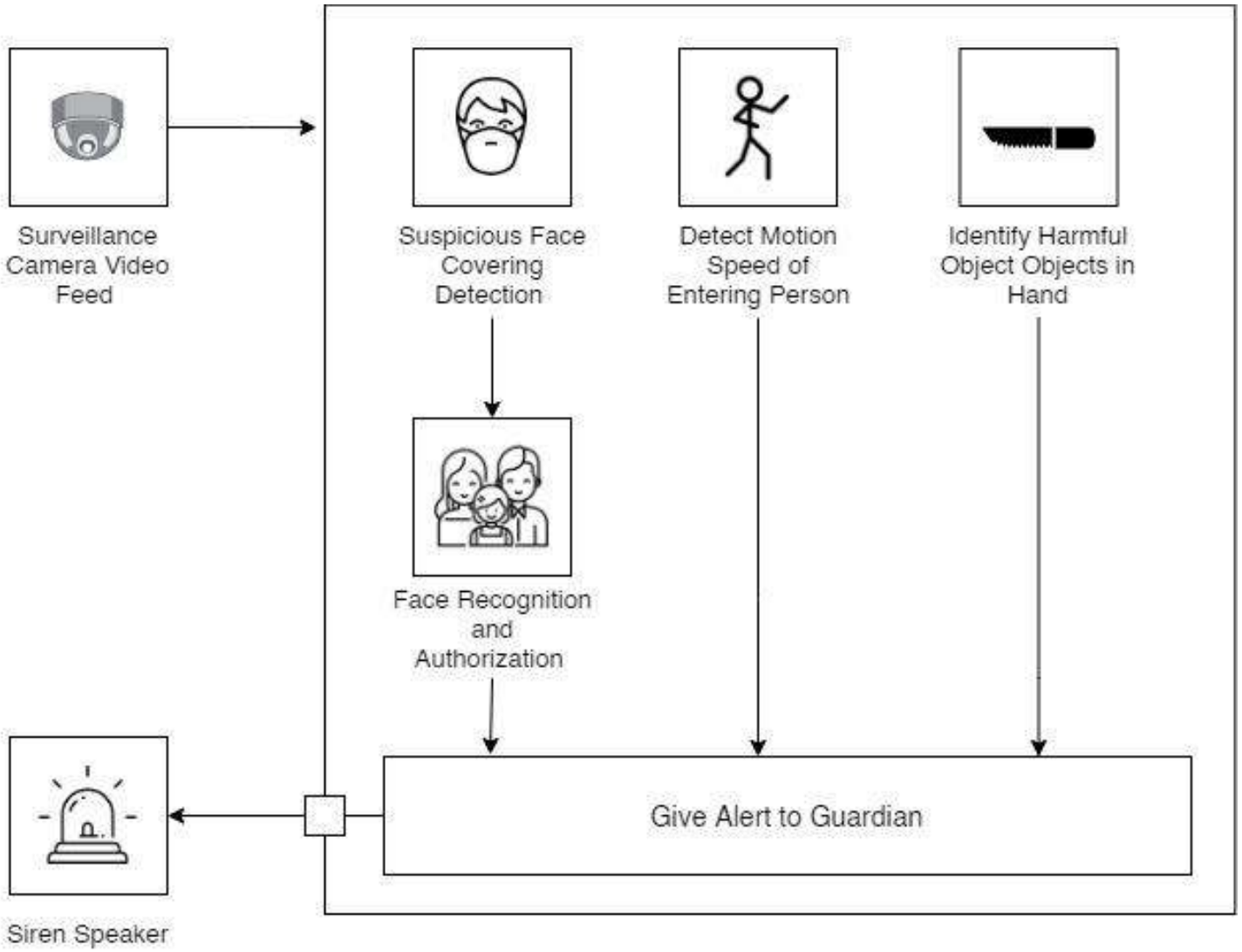
-The proposed solution will be implemented with the explained motive by indicating the caretakers or parents of such incidents and to prevent harm to minors as the system makes sure to notify the responsible adults subsequent to detecting kidnapping suspect.

Objectives

- Specific Objectives

1. Identify suspicious face covering
2. Face recognition and authorization
3. Detect motion speed of entering person
4. Identify harmful objects in hand

System Overview Diagram



Technologies, Techniques, Algorithms

- Suspicious Face Covering Detection
  - Algorithm : Skin Detection
  - Technology : OpenCV
- Steps :
  1. Take image input from camera
  2. Detect Skin
  3. Classify using CNN classifier

- Face Recognition and Authorization
  - Algorithm : Face recognition
  - Technology : OpenCV
- Steps :
  1. Take image input from camera
  2. Detect Face
  3. Compare with the faces in the database

Technologies, Techniques, Algorithms

- Motion Speed Detection
  - Algorithm : Speed Detection
  - Technology : OpenCV

- Steps :
  1. Take input as video frames from camera
  2. Track the person
  3. Get velocity of the person moving between two frames

- Harmful Objects in Hand
  - Algorithm : Hand Detection
  - Technology : OpenCV

- Steps :
  1. Take image input from camera
  2. Detect Hand
  3. Use object detection to detect presence of harmful object

Requirements

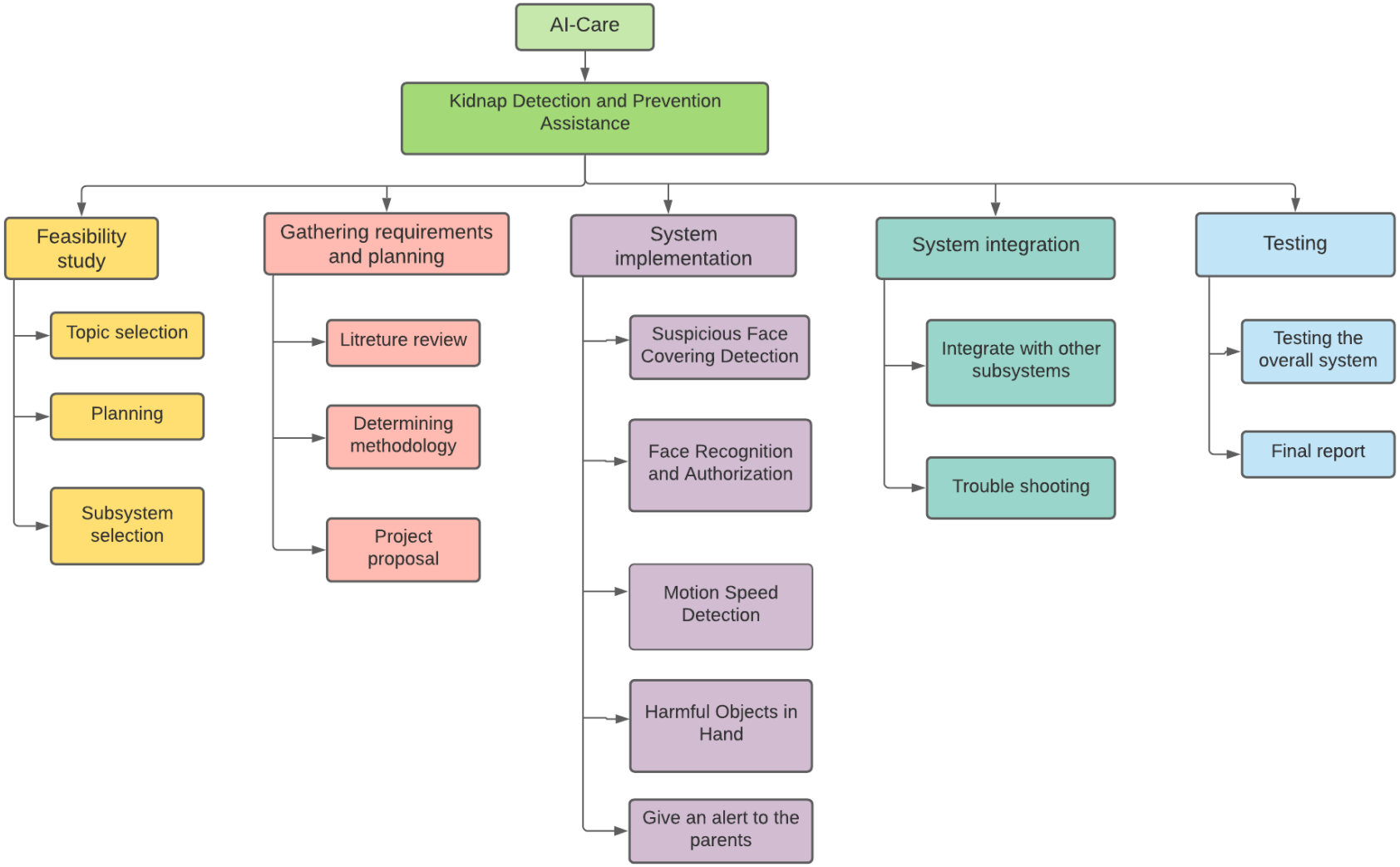
Functional Requirements
- Integration should be allowed between subsystems.
- There should be a way to capture the persons face.
- There should be a way to identify child separately.

Non-Functional Requirements
- Response time and net processing time.
- Efficiency
- Availability

Personal Requirements
- Parent/Guardian should be available.
- Child should listen to the warnings.
- Parent/Guardian should react to the alerts.

Hardware Requirements
- There should be a way to configure the speaker to the system
- There should be a way to configure the camera to the system

Work Breakdown Structure



Budget

Hardware Resource	Quantity	Estimated Price
Surveillance Camera	2	Rs 7000 *2
Speaker	2	Rs 1000 *2
Touch Sensor	1	Rs 300
Total	5	Rs 16300 /=

References

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Data Science

Background

- 37% of deaths in children are between the age of one and four using hazardous objects.

- These accidents are avoidable and most of them happened in a chain of events.

- Probability of children facing dangerous accidents increase when
    - Parents are employed and stressed from work
    - Kids are not having a good relationship with the parents
    - Children don't have a safe place to play
    - Hazardous or unsafe objects are kept in kids' area accidentally.

Background

- Automated surveillances had significant growth since past decade.
- Surveillance was used for abnormal behavior detection, feature detection, object detection, action recognition etc.
- None of these surveillance methodologies had potential ability in child safeguard.
- Not all these methods worked ideally in real-time.
- The computation power to be able to perform detections were insufficient.

Research Gap

Product	Research A [2] [6] [7]	Research B [3] [4]	Research C [5]	Research D [8] [9]	Proposed solution (AI Care)
Child Surveillance System	✓	✗	✗	✗	✓
Real Time Object Detection	✗	✗	✓	✓	✓
Real Time Sharp Object Detection	✗	✗	✗	✓	✓
Classify the danger level	✗	✗	✗	✗	✓
Child detection	✓	✗	✗	✗	✓
Identify child is in proximity to hazardous object	✗	✗	✗	✗	✓
Prevent accidents before happening	✗	✗	✗	✗	✓

Research Question

- The pandemic situation compelled parents to work from home arrangements.
- Mothers are forced to balance office work along with balancing their roles as a mom and wife at the same time.
- Babysitters seems to appear as a promising solution but leaves the question how safe it is?
- Annually an average of 2000[1] kids die from home injuries.
- The main cause for home accidents is general negligence of safety at home and the lack of supervision.

Objectives

- Main Objective

  - Capturing harmful child events and dangerous objects effectively and accurately, taking prompt responsive actions to avoid danger.

Objectives

- Specific Objectives

    - Hazardous object localization

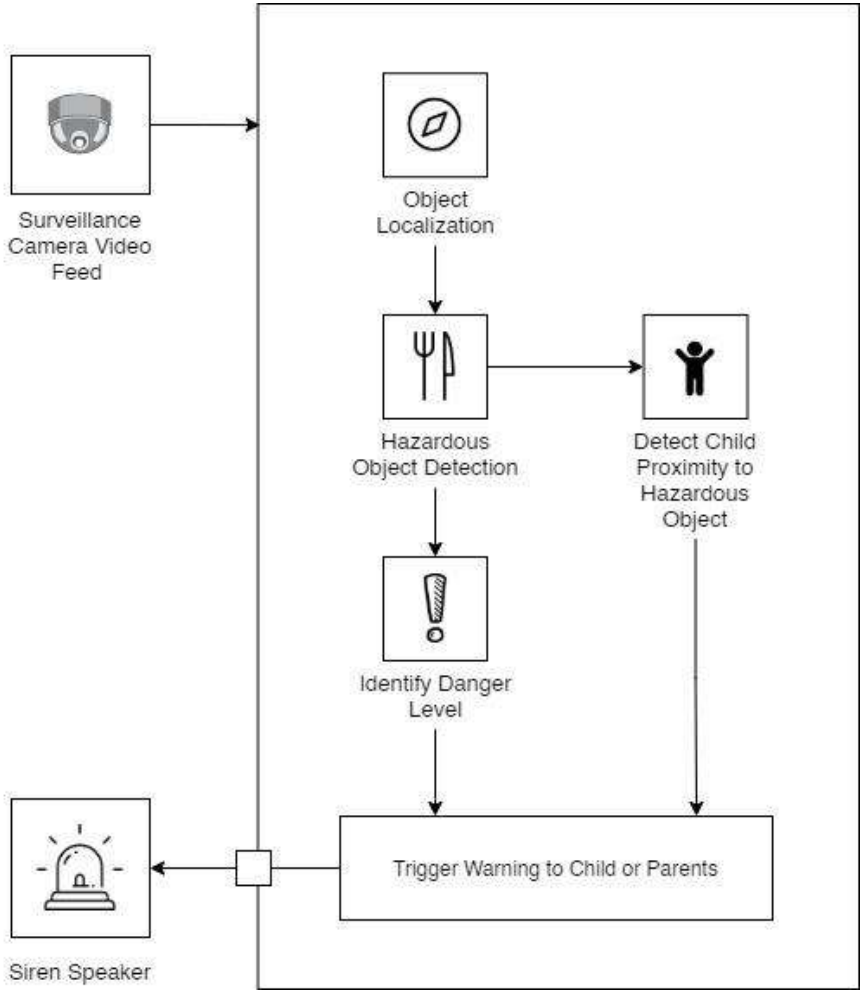
    - Classify sharp objects and possible hot liquid containers

    - Identify the danger level of object

    - Detect child in proximity to hazardous object

    - Trigger warnings to child or give alert to parent as suitable to the situation

SYSTEM DIAGRAM



Technologies, techniques, algorithms to be used

OpenCV, Keras, NumPy, sklearn, TensorFlow, Python

Hazardous Object Detection : YOLOv3 to detection hazardous object and classify its danger level

Identify Child Activity : YOLOv3, SORT (Simple Online Real-time Tracking) to classify whether Child is in proximity to a hazardous object

Functional Requirements

Should have a method to localize the hazardous objects in child area

Should have a method to classify the hazardous object danger level (Hot liquid container has high risk)

Should have a method to detect child’s actions without identifying parents' actions.

Should have a method to classify whether Child is in proximity to a hazardous object.

Should have a method to distract child activity or alert to the parents or caregiver about the danger.

Non-Functional Requirements

System efficiency and performance

Availability

Accuracy

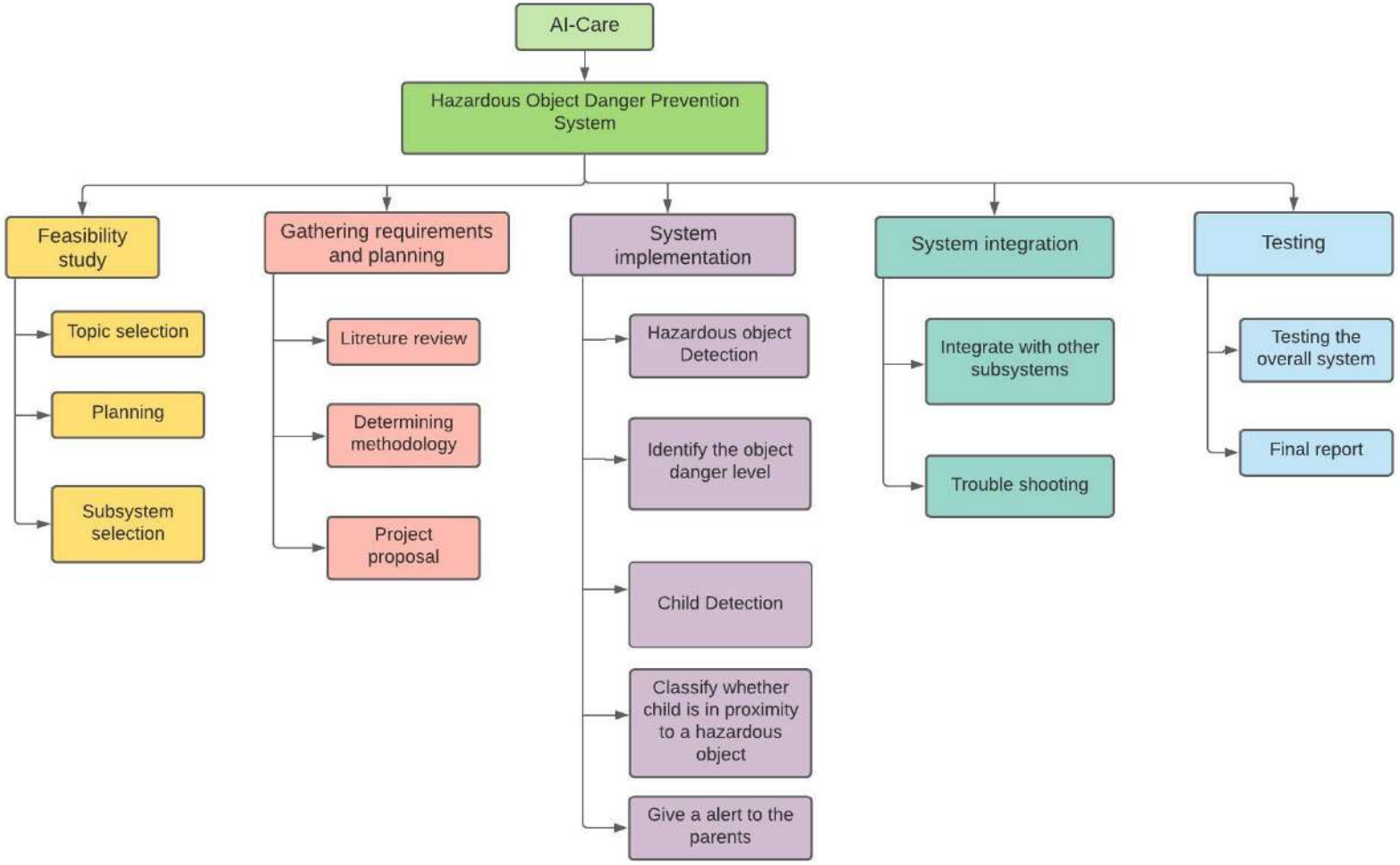
Personal Requirements

- Parent/Guardian should be available.
- Child should listen to the warnings.
- Parent/Guardian should react to the alerts.

Hardware Requirements

- There should be a way to configure the speaker to the system
- There should be a way to configure the camera to the system

Work Breakdown Structure



Budget

Hardware Resource	Quantity	Estimated Price
Surveillance Camera	2	Rs 7000 *2
Speaker	2	Rs 1000 *2
Touch Sensor	1	Rs 300
Total	5	Rs 16300 /=

References

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IT17167710 | PRATHAPA D.M.J

DATA SCIENCE

Background

- Falls are the most common cause of accidental injury to children.
- While most falls aren't serious – active children often fall over – some falls can lead to death or long-term disability.
- Fall accidents may occur when climbing to a high place in a daily living space.
- Child fall accidents are thought to occur according to the following process: a baby climbs to a height through a product (e.g., a chair, a desk, or a bookshelf) and then falls from a high location by losing balance.
- As such it is important to prevent fall-related injuries happen at home to keep your children safe.

- If we can predict the climbing behaviour that leads to a fall accident, the location of the risk of a fall accident can be determined.

- The parents can be notified of the risk in advance, and the daily living space can be improved so that the child cannot climb to dangerous high locations.

Research Gap

- Child climbing to a dangerous position, leaving the safe zone boundary of the room and Fall-induced injuries are common in the young children.
- Various types of approaches have been made to handle this situation. One of the approaches is by wearing a sensor that can be used to detect acceleration of the falls.
- However, if the parent forgot to wear the sensor to the child, no falls can be detected even when the incident happened.
- In order to overcome these difficulties, we can use computer-based vision techniques that does not require that the person has to wear anything.
- An additional reason for using such system is that a camera can give more data and accuracy on the motion of a person actions than an accelerometer.

Comparison between existing Research and Products

Product	[1] [2]	[3] [4] [5]	[6] [7]	[8] [9] [10]	**Proposed solution (AI Care)**
Fall detection algorithm	✓	✓	✓	✓	✓
Climb detection algorithm	✓	✗	✗	✗	✓
Taking prompt responsive actions to avoid danger (alerts)	✓	✓	✓	✗	✓
Child detection	✓	✗	✗	✗	✓
Capture safety zone boundary breach	✗	✗	✗	✗	✓
Discriminate falls from a child sitting down abruptly	✗	✗	✗	✗	✓
Differentiate between a real fall and an incident in which a person is lying	✗	✗	✓	✓	✓
Calculate child midpoint & Calculate the average safe height of the room.	✗	✗	✗	✗	✓
Height and hazard segmentation	✗	✗	✗	✗	✓

Research Problem

- The role of a working mom is no brainer but an obvious victim of the explained situation as her life is sandwiched between the two roles: the role of a mom and a wife's role.
- Due to the pandemic situation, most of the corporates changed their rosters and working plans to work from home.
- Mothers are forced to balance office work along with balancing the two roles mentioned earlier which can be hectic.
- Fells are the most common cause of accidental injury to children.
- Some falls can lead to death or long-term disability
- Preventing serious falls is a major problem for a working mother as well as for a caregiver as and when they are keeping a watchful eye to look after their young kids all the time at home.
- Given the scenario is such, a babysitter sounds like a good idea but then again leaves us with a question mark on how safe it is.
- The main aim of this research is to Capture safety zone boundary breach and spot unsafe heights from the current position. effectively and accurately and taking prompt responsive actions to avoid danger.

Main Objective

- The main objective is to ensure the safety of children in the early development stages by tracking their motion and prevent them from reaching cautious heights that could result in injuries.

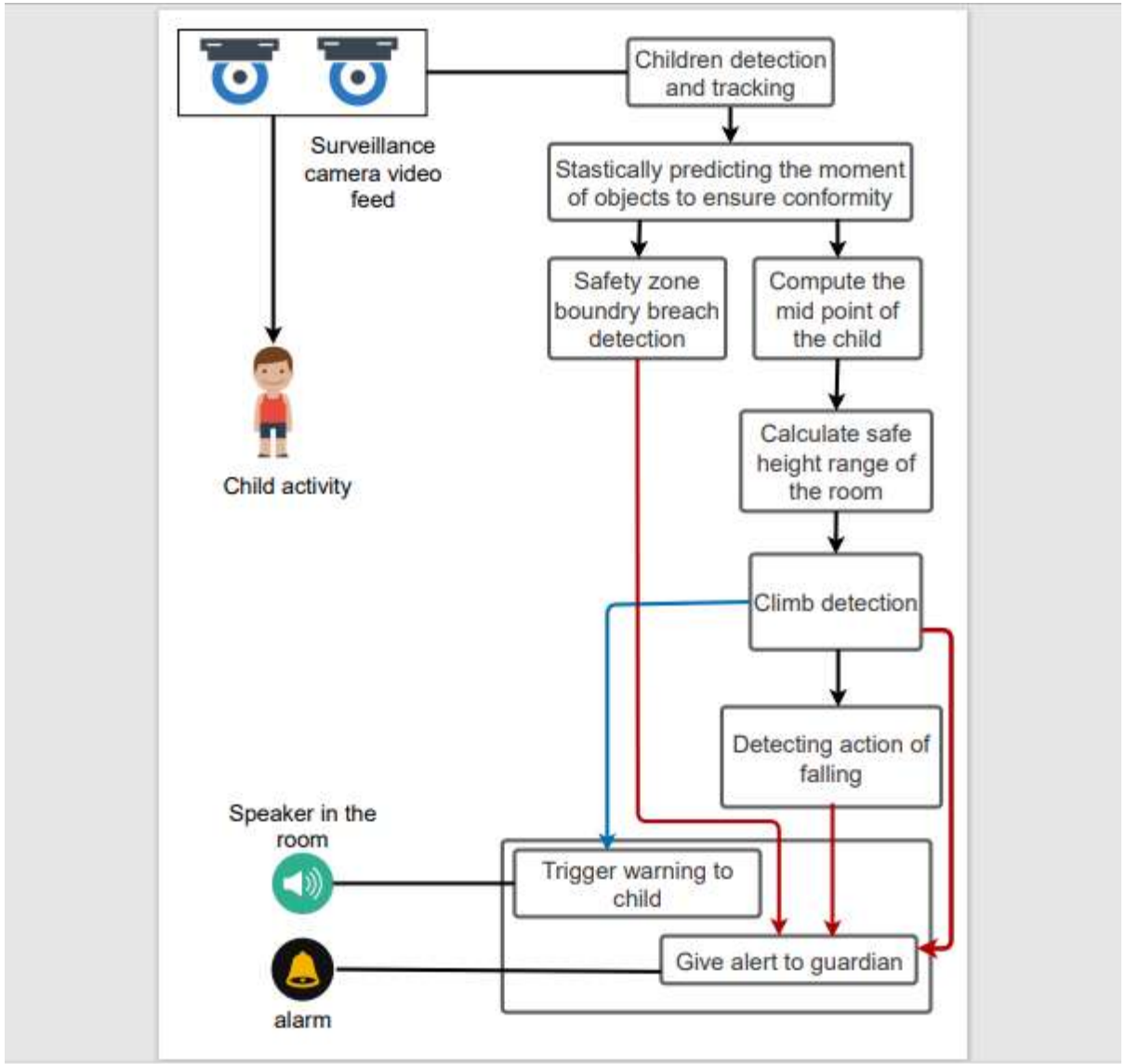
- The proposed solution will be implemented with the explained motive by indicating the caretakers or parents of such behavior and to prevent or diminish harm to minors as the solution makes sure to notify the relevant parties subsequent to detecting menacing actions as described.

Specific Objectives

Following specific objectives needs to be attained to archive the main objective.

- detect whether the actions were caused by an adult or a child
- calculate the mid-point of the captured child and calculate safe height range of the room utilizing computer vision.
- Capture safety zone boundary breach and spot unsafe heights from the current position and taking prompt responsive actions to avoid danger.
- Height and hazard segmentation
- detecting the action of falling over and to communicate the incident efficiently to the parent or caregiver.

System Diagram



Technologies, Techniques, Algorithms

OpenCV , keras , NumPy ,sklean ,Pillow, Open Pose ,TensorFlow

- **Detection**: **YOLOv3** to detect child on each of the video frames.
- **Tracking**: **Deep_SORT** to track child activity over different frames (*Simple Online and Realtime Tracking with a Deep Association Metric*).
- compute the **midpoint** of child and average safe height of the room with computer vision (**“pixels per metric” ratio)**
- A **Kalman filter** implementation and concrete parametrization for image space filtering.

Functional Requirements

- Should have method to detect whether the actions were caused by an adult or a child.
- Should have a method to calculate child mid point and the safe height range of the room.
- Should have a method to Capture safety zone boundary breach and spot unsafe heights from the current position.
- Should have a method ay to detect the action of falling .
- Should have a method ay to communicate the incident efficiently to the parent or caregiver.

Non-Functional Requirements

- Efficiency and performance of the system.
- Ensuring system availability and accuracy

Personal Requirements

- Parent/Guardian should be available.
- Child should listen to the warnings.
- Parent/Guardian should react to the alerts.

Hardware Requirements

- There should be a way to configure the speaker to the system
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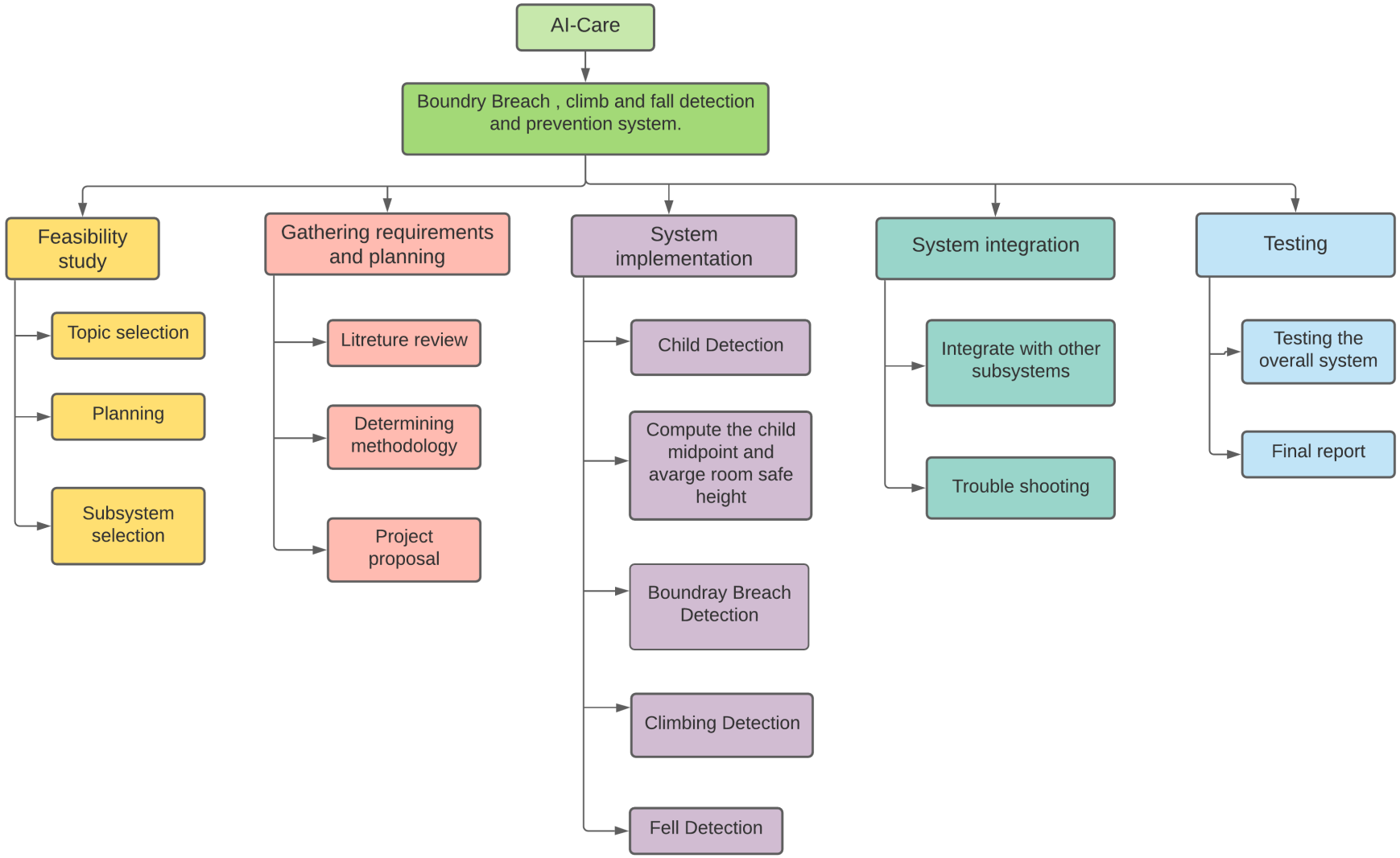
Work Breakdown Structure



Budget

Hardware Resource	Quantity	Estimated Price
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Speaker	2	Rs 1000 *2
Touch Sensor	1	Rs 300
Total	5	Rs 16300 /=

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References

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IT18255720 | JAYAKODY J.M.A.M.S

Data Science

Background

- In today childcare has become a daily challenge for many families since parents cannot continuously monitor their babies' conditions either in normal or abnormal situations. Because of this reason, babies are more likely to be exposed to various hazards nowadays.

- **One of them is the damage caused to Children by touching unsafe electrical appliances.**

- The parent can prevent this by monitoring the baby’s behavior using a cctv camera, but there is no immediate way to notify the parent in the event of an accident and it can be difficult for the parent to keep an eye on the cctv camera screen continuously.

- This component aims to address this issue by introducing an IoT based real time baby behavior detection and monitoring system.

Research Gap

RESEARCH PROJECTS	Alerting system with IOT	Geometric features of face	Texture of body parts	Texture of skeleton
Children Detection Algorithm Based on Statistical Models and LDA in Human Face Images	Not Available	Available	Not Available	Not Available
Combination of Texture and Geometric Features for Age Estimation in Face Images	Not Available	Available	Available	Not Available
An Image-Based Method of Distinguishing Children from Adults	Not Available	Available	Available	Not Available
Modelling geometric features for face-based age classification	Not Available	Available	Not Available	Not Available
Classification of Age Groups Based on Facial Features	Not Available	Available	Not Available	Not Available
PROPOSED SOLUTION	**Available**	**Available**	**Available**	**Available**

Research Problem

- The most common cause of home injuries is a general disregard for personal protection and a lack of oversight.
- Every year, an average of children getting injured as a result of unsafe electrical appliances sustained at home.
- In order to Address these issues based on surveillance camera and IOT based technologies, required to detect child over adult very effectively and efficiently.
- Did we have effective and efficient way to detect child ???

Objectives

- **What is the main Objective ?**
  - Child and adult classification.

    -Trigger the alerting system based on the person(Child or adult) who touched the sensor

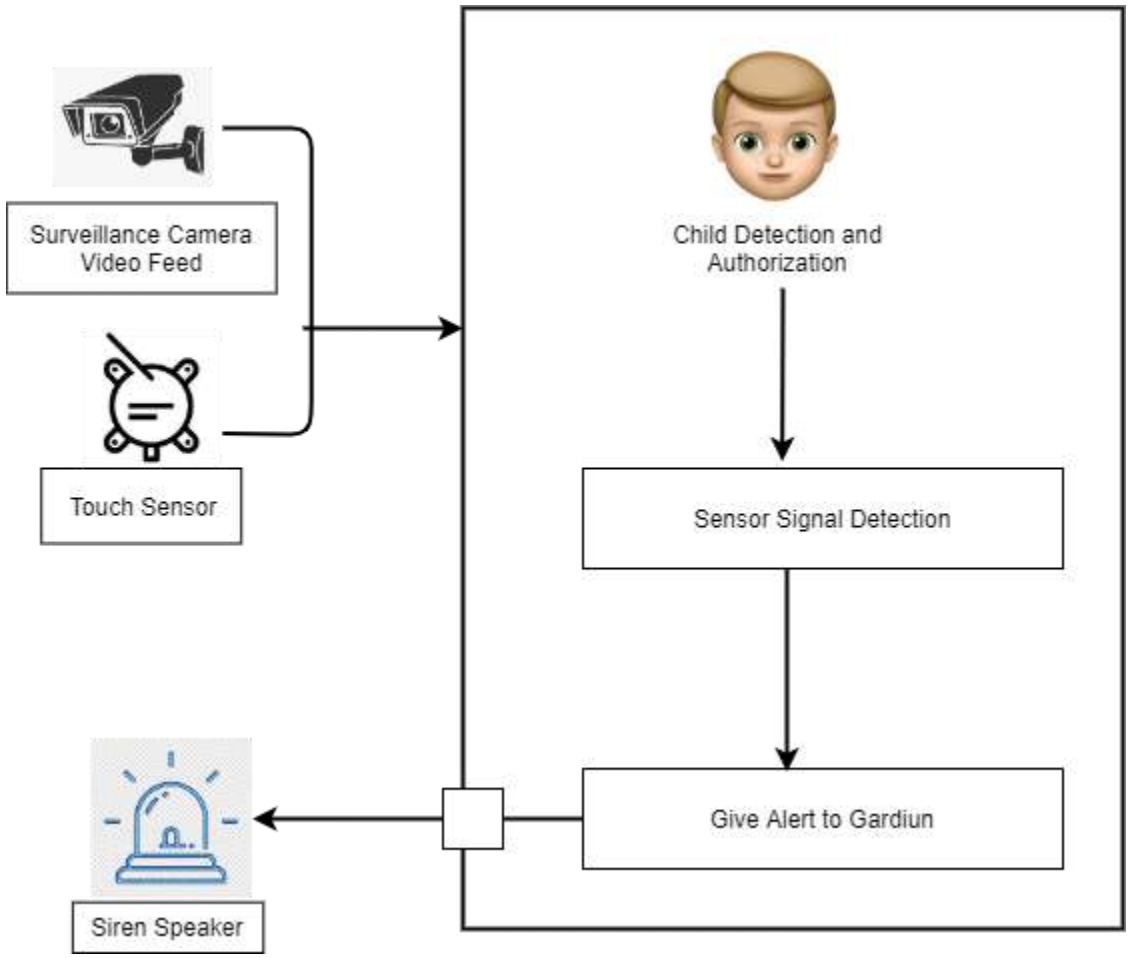
  - Recognize harmful electrical devices in the environment and Attach the IOT devices (Touch sensor) on top of the electrical devices.

Objectives

- **What are the specific objectives ?**

  - identify proper touch sensor which is suits for the environment.
  - Human detection
  - Adult child classification
  - Trigger an alert message based on the sensor touched person.

SYSTEM DIAGRAM



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Technologies, techniques, algorithms to be used

- OpenCV, Keras, NumPy, sklearn, TensorFlow, Python

Functional Requirements

-Should have a method to detect the human in the specific environment

-Should have a method to classify whether Child or adult.

-Should have a method to communicate with the IOT device.

-Should have a method to Trigger an alert to the parents.

Non-Functional Requirements

-System efficiency and performance

-Availability

-Accuracy

-Scalability

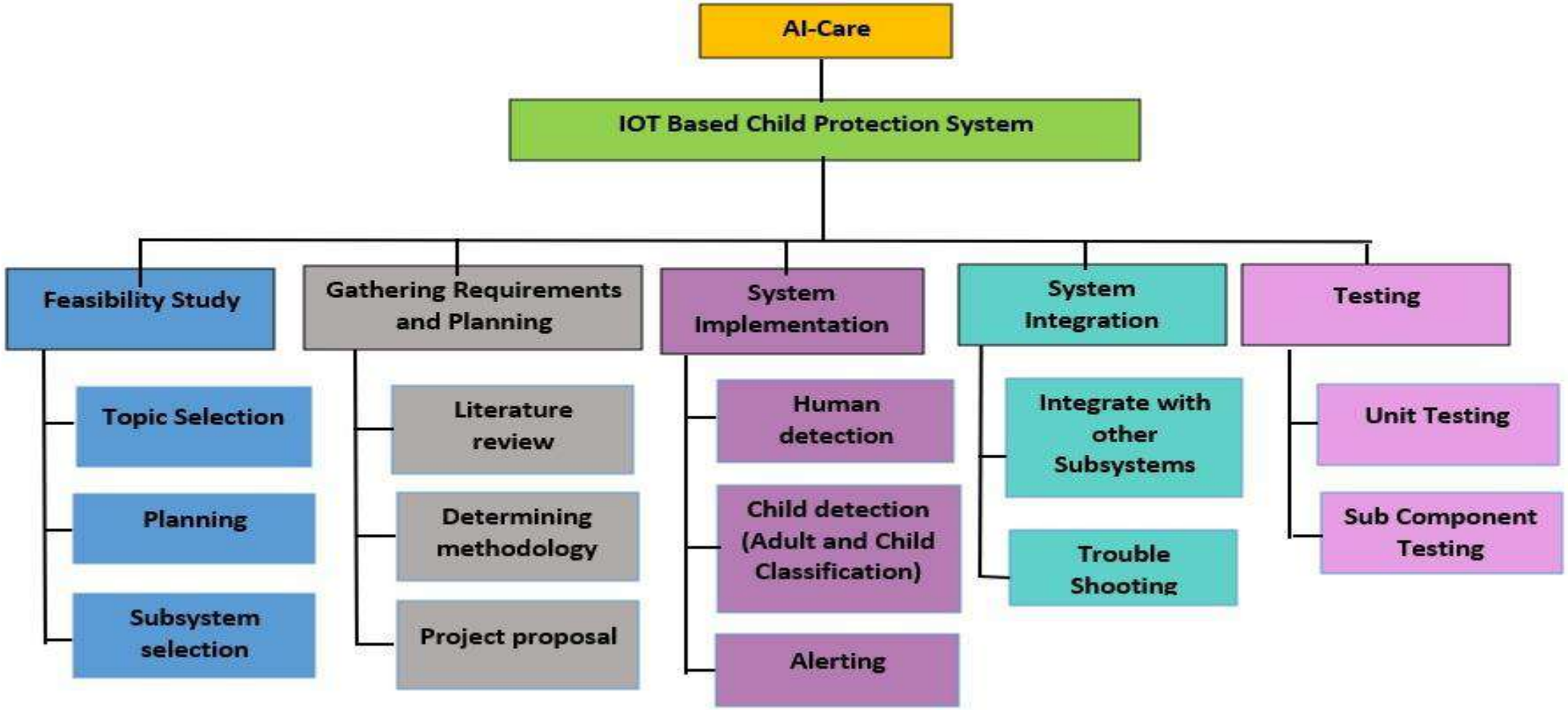
Personal Requirements

- Parent/Guardian should be available.
- Child should listen to the warnings.
- Parent/Guardian should react to the alerts.

Hardware Requirements

- There should be a way to configure the speaker to the system.
- There should be a way to configure the camera to the system.
- There should be a way to configure touch sensor to the system.

Work breakdown structure



Budget

Hardware Resource	Quantity	Estimated Price
Surveillance Camera	2	Rs 7000 *2
Speaker	2	Rs 1000 *2
Touch Sensor	1	Rs 300
Total	5	Rs 16300 /=

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Thank you