HIGH LEVEL DESIGN DOCUMENT

Infantza: Computer Vision and Deep Learning enabled Infant Surveillance System

UE19CS390A – Capstone Project Phase – 1

Submitted by:

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Note:

Section – 1 & Section 2	**Common for Product Based and Research Projects**
Section 3 to Section 11	**High-Level Design for Product Based Projects.**
Section 12	**High-Level Design for Research Projects.**
Appendix	**Provide details appropriately**

1. Introduction

With the rise in complexities in the job roles of today's parents and their hectic schedules, the need for infants to be observed frequently when left in the care of a babysitter, to avoid any kind of injuries and to constantly have an eye upon them all day becomes a tedious task. In today's world small infants and children being subjected to abuse from caretakers and others has become a serious issue due to which parents are unable to entrust them with the safety of their child. A huge percentage of women end up leaving their professional dreams behind to take care of their infants because of concerns with respect to their safety. Parents shall not be able to spend all their time in their workspaces devoted to check if their child is fine, hence an efficient alert system is required in order to detect any kind of dangerous situations.

Through this project we intend to develop an infant monitoring system that will provide alerts to parents in case of the infant being subjected to any harm when left with the caretaker.

The cases for which the notification is to be sent are:

- Hitting the infant
- Infant choking
- Infant crying
- Any harmful objects in the vicinity of the infant.
- Strangers presence near the infant
- Absence of the infant from the region being covered.

Environment: The project environment shall be strictly constrained to that of a home environment within which the infant's room would be monitored.

Constraints:

- This infant monitoring system shall be developed keeping in mind an infant below the age of 1 year.
- The system shall be able to monitor a single infant at a time.

The infant monitoring system can be used generically by anyone with the prerequisite of having to feed the photos of themselves and their infant prior to using the Application.

The functionalities that will be provided by the system include:

- Conversion of the input real time video into frames.
- Extraction of features.
- Classification of normal and abnormal behavior by the model.
- Notification to parents on harm detection
- Facial recognition to recognize and distinguish strangers from members of the house and notification on identification of strangers.

2. Current System [if applicable]

The currently existing system with respect to infant monitoring has been implemented using Internet of Things(IoT) and also with machine learning. The tasks that have been handled in the existing system involves only the detection of harm occurring to an infant in a particular situation and the categories of harmful activities that are being handled are also limited to a few.

3. Design Considerations

3.1. Design Goals

Newly proposed system:

In the scenario when an infant below the age of 1 year is left with a caretaker, we seek to develop a model using computer vision and deep learning for infant monitoring with an alert system in order to alert the parents when the infant is subjected to any harm or is in any unusual situation, thereby avoiding the need for 24/7 constant monitoring of the infant.The monitoring would mainly be required only when an alert has been issued indicating the occurrence of an abnormal situation. Some of the cases we intend to address include the infant crying, being hit, choking, any harmful objects in its vicinity and absence of the infant from the region being covered.We will also

include a facial recognition system that will help us to detect the presence of any stranger in the infant's vicinity and an alert will be sent to the parents in all such situations.

Difference between new and existing system:

The tasks that have been handled in the existing system for infant monitoring involves only the detection of harm occurring to an infant in a particular situation where the categories of harmful activities that are being handled are limited to a few.

The newly proposed system that we seek to implement will cover a broader range of dangerous situations that an infant might be exposed to which include the infant crying, being hit, choking, any harmful objects in its vicinity and absence of the infant from the region being covered.We will also include a facial recognition system that will help us to detect the presence of any stranger in the infant's vicinity and an alert will be sent to the parents in such a situation.

Quality of Services Characteristics of the system:

Availability:

We intend to make our application available to our users 24 hours a day, seven days a week, extremely accessible at all times.

Security:

1. Security in terms of allowing access by setting usage limitations.
2. Facial Recognition to enhance application security .
3. Usage Limitations: The usage limitation can be imposed on the application by setting a limit of allowing a maximum of 4 people to access the CCTV footage using a single login.

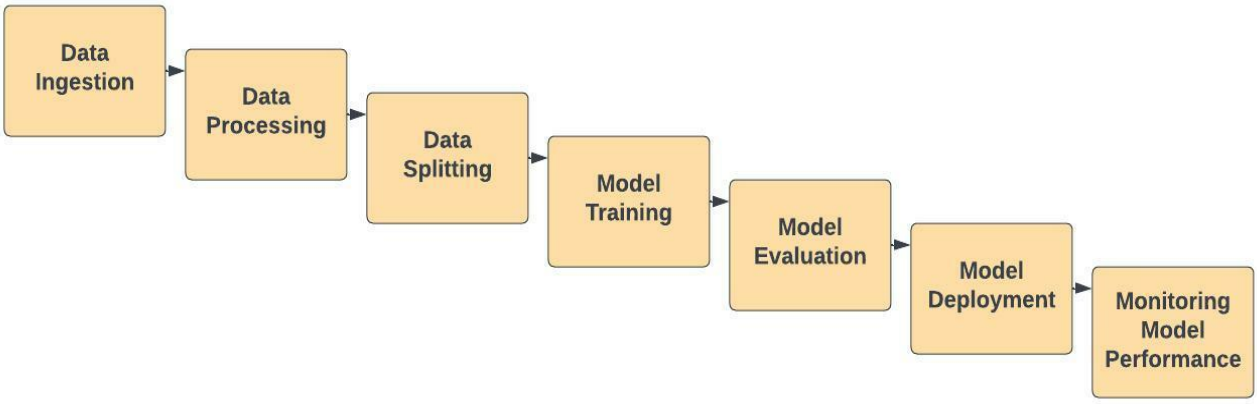
Privacy:

1. **Authentication**: Giving the user access and ensuring that the users are legitimate. The first step in a successful identity and access management strategy is authentication.

Speed:

Fast In Real time: The model must be able to detect abnormal activity and send notifications within minimal time in real time.

3.2. Architecture Choices



Pipeline Architecture

3.3. Constraints, Assumptions and Dependencies

Assumptions:

1. This infant monitoring system shall be developed keeping in mind an infant i.e below the age of 1 year.
2. The project environment shall be strictly constrained to that of a home environment within which the room in which the infant would be in is monitored.
3. The system shall be able to monitor a single infant at a time.

Hardware Requirements:

1.High Resolution CCTV Surveillance Camera for the purpose of real time capturing.

2. GPU(provided by Google Collaboratory)

Software Requirements:

1.Python

2.Platform - most probably Google Collaboratory

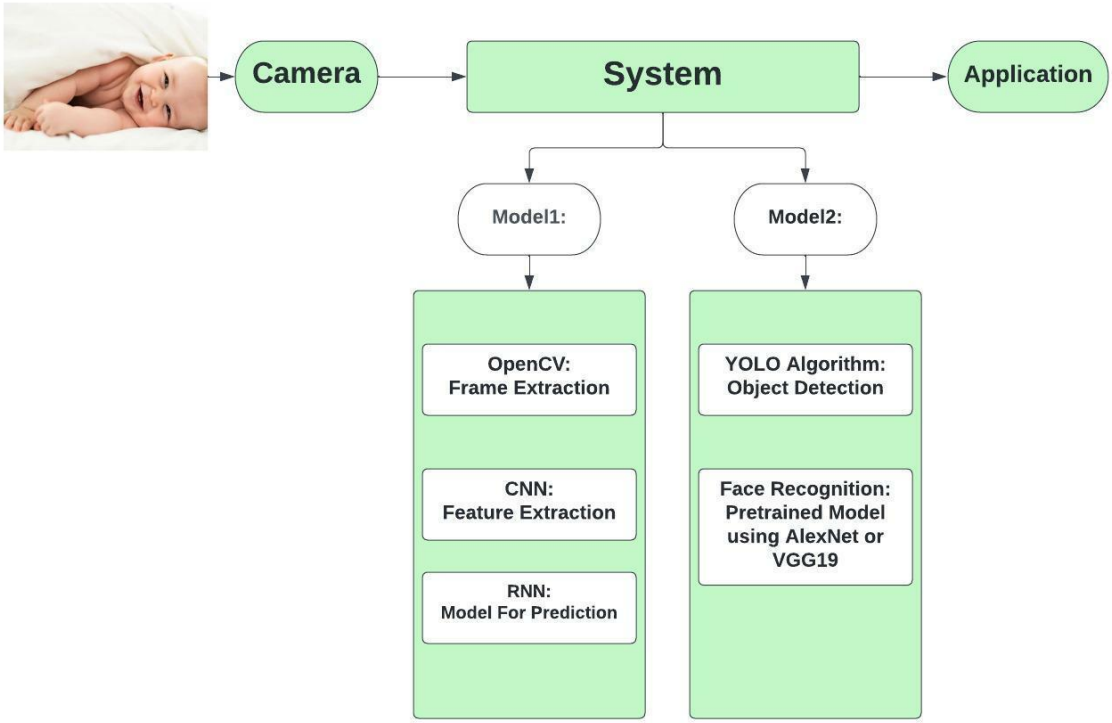
3.Python libraries.

4.Tensorflow

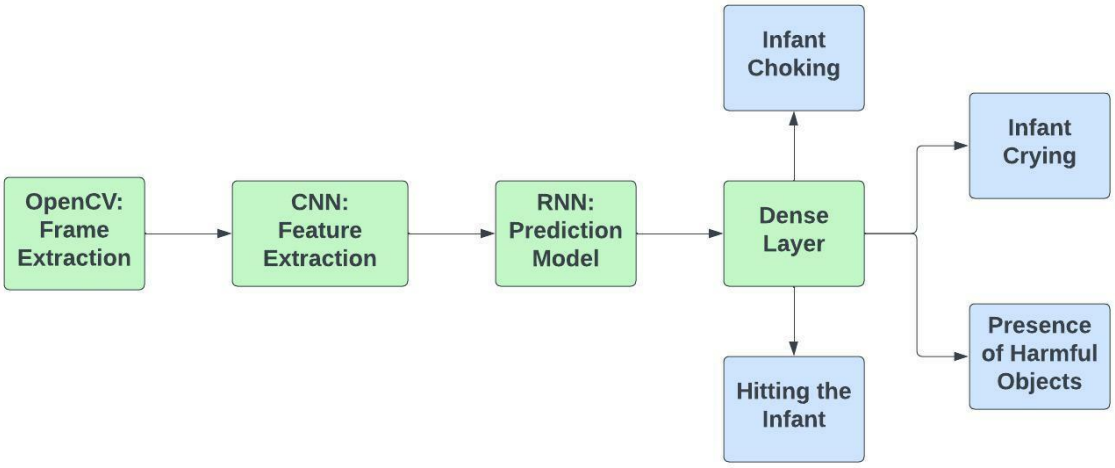
5.Flutter

6.Google AI

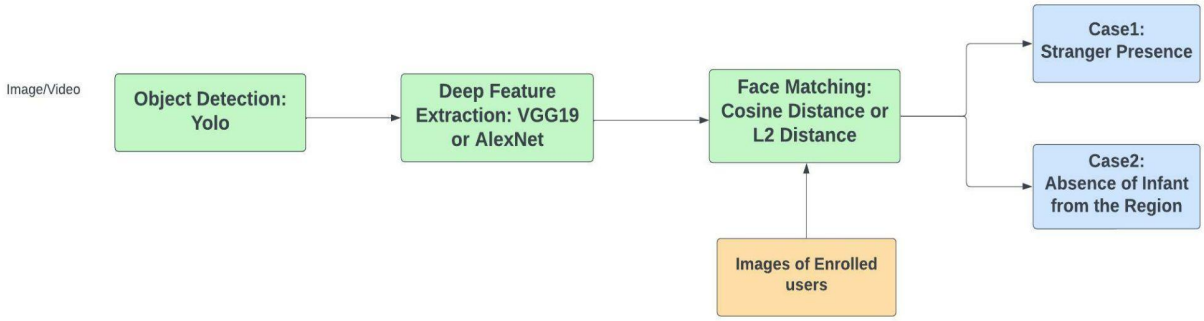
4. High Level System Design



4.1 Model 1:

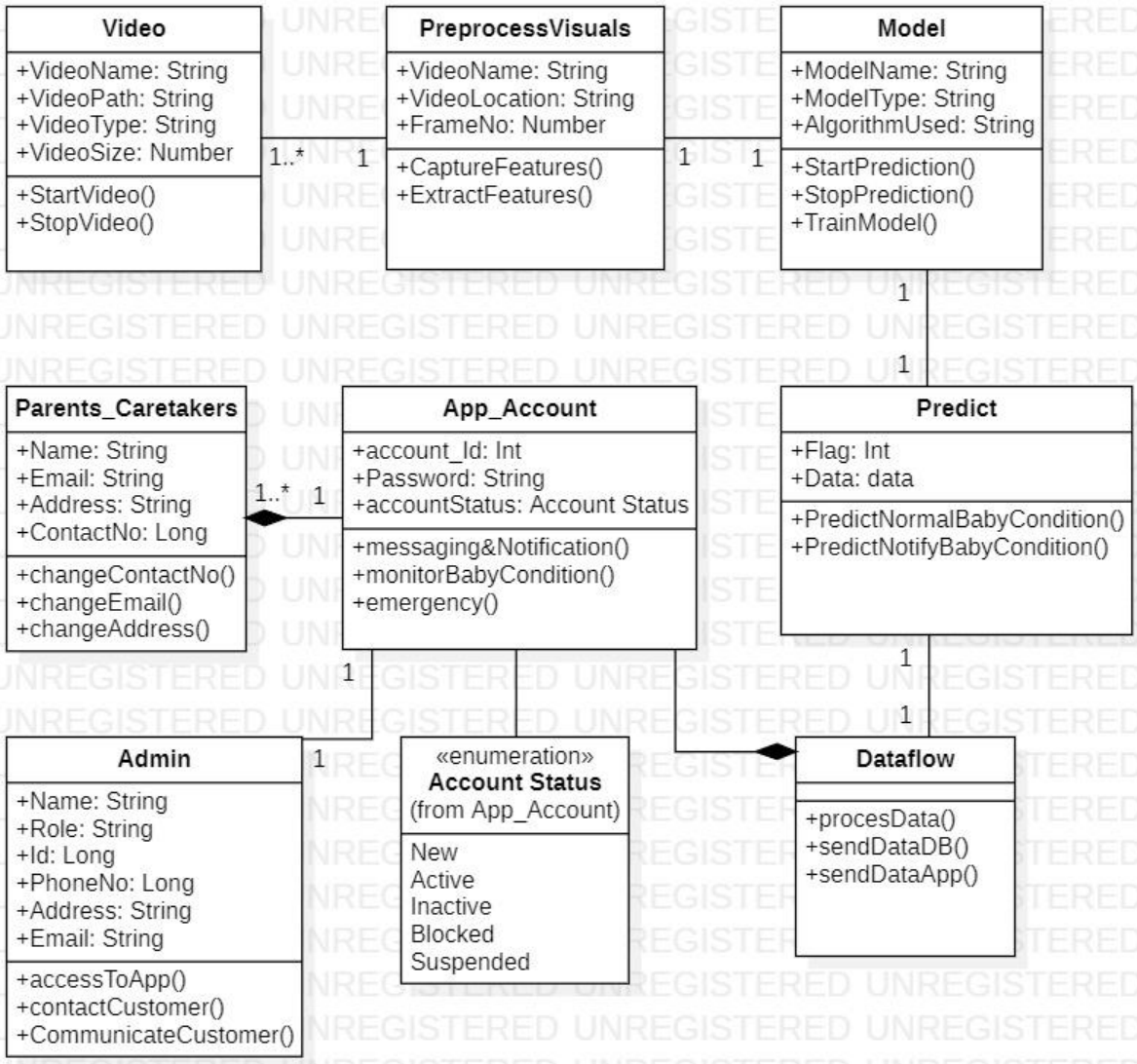


4.2 Model 2:



5. Design Description

5.1. Class Diagram

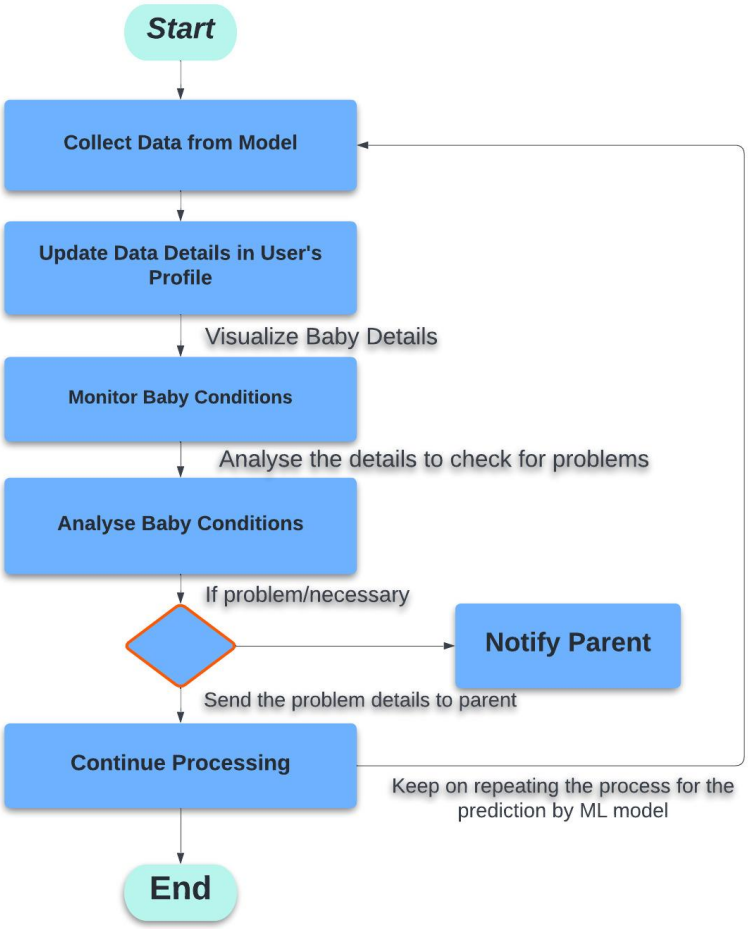


5.2. Reusability Considerations

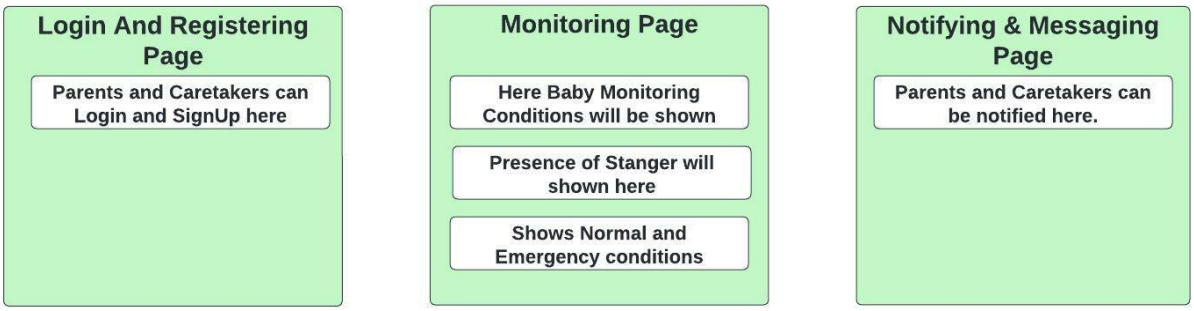
Not Applicable

6. ER Diagram / Swimlane Diagram / State Diagram (include as appropriate)

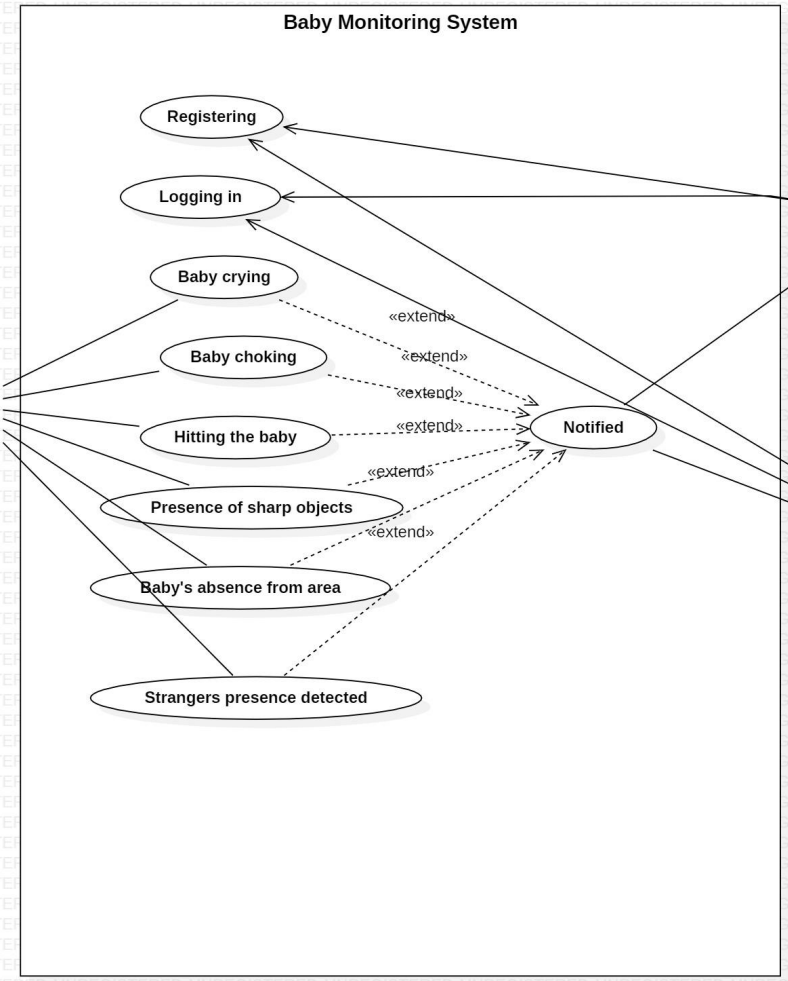
Activity Diagram



7. User Interface Diagrams



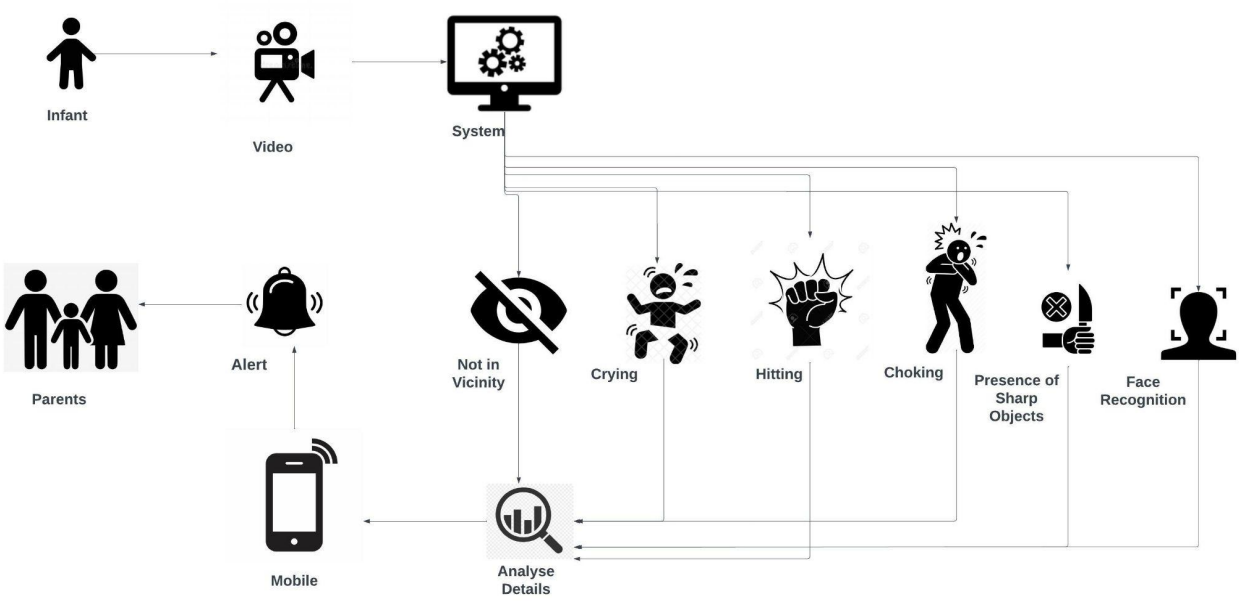
7.1 Use Case Diagram:



8. Report Layouts

Not Applicable.

9. External Interfaces



10. Packaging and Deployment Diagram

Not applicable.

11. Help

Not currently applicable.

12. Design Details

1.1. Novelty

The tasks that have been handled in the existing system for infant monitoring involve only the detection of harm occurring to an infant in a particular situation where the categories of harmful activities that are being handled are limited to a few.

The newly proposed system that we seek to implement :

- Will cover a broader range of prospectively dangerous situations that an infant might be exposed to which include the infant crying, falling, being hit,choking, any harmful objects in its vicinity and absence of the infant from the region being covered.
- Will include a facial recognition system that will help us to detect the presence of any stranger in the infant's vicinity and an alert will be sent to the parents in all such situations.
- There is no existing dataset for this project. So, we will be synthesizing our own dataset .

1.2. Innovativeness

The newly proposed system that we seek to implement :

1. Will cover a broader range of dangerous situations that an infant might be exposed to which include the infant crying, falling, being hit, choking, any harmful objects in its vicinity and absence of the infant from the region being covered.
2. Will include a facial recognition system that will help us to detect the presence of any stranger in the infant's vicinity and an alert will be sent to the parents in all such situations.
3. There is no existing dataset for this project. So, we will be synthesizing our own dataset .

1.3. Interoperability

Not currently applicable.

1.4. Performance

We seek to achieve good performance in our project. As the project is to be implemented in real time ,the Deep learning model must be able to detect abnormal activity and send notifications within minimal time in real time.

1.5. Security

1.Security in terms of allowing access by setting usage limitations.

2.Facial Recognition to enhance application security

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Usage Limitations: The usage limitation can be imposed on the application by setting a limit of allowing a maximum of 4 people to access the CCTV footage using a single login.

1.6. Reliability

Not currently applicable.

1.7. Maintainability

Not currently applicable.

1.8. Portability

Not currently applicable.

1.9. Legacy to modernization:

The initial approach using IoT had the usage of multiple hardware components.The number of components have been minimized by using a single high resolution camera and deep learning techniques.

1.10. Reusability

Not currently applicable.

1.11. Application compatibility

Not currently applicable.

1.12. Resource utilization, Etc.,

Not currently applicable.

Appendix A: Definitions, Acronyms and Abbreviations

- YOLO : You Only Look Once
- SVM : Support Vector Machines
- CNN : Convolutional Neural Network
- DL : Deep Learning
- DNN : Deep Neural Network
- K-NN : K Nearest Neighbours
- ML : Machine Learning

Appendix B: References

- https://ieeexplore.ieee.org/abstract/document/8418143
- ttps://www.sciencedirect.com/science/article/pii/S1877050920308942
- https://www.sciencedirect.com/science/article/pii/S2666285X21000728
- https://ieeexplore.ieee.org/abstract/document/840634
- https://ieeexplore.ieee.org/document/9342230
- https://ieeexplore.ieee.org/document/6324590
- https://ieeexplore.ieee.org/document/9292058
- https://ieeexplore.ieee.org/document/8110157
- https://www.researchgate.net/publication/344331972_Facial_Emotion_Detection_Using_Neural_Network?enrichId=rgreq-94073a368fca02c239006d92df09ccad-XXX&enrichSource=Y292ZXJQYWdlOzM0NDMzMTk3MjtBUzo5MzgyNTc4MzU2NDI4ODJAMTYwMDcwOTUwODIxNA%3D%3D&el=1_x_3&_esc=publicationCoverPdf
- https://ieeexplore.ieee.org/abstract/document/9154121
- R. Pathak and Y. Singh, "Real Time Baby Facial Expression Recognition Using Deep Learning and IoT Edge Computing," 2020 5th International Conference on Computing, Communication and Security (ICCCS), 2020,pp.1-6,doi:10.1109/ICCCS49678.2020.9277428.
- P. Sivakumar, J. V, R. R and K. S, "Real Time Crime Detection Using Deep Learning Algorithm," 2021 International Conference on System, Computation, Automation and Networking (ICSCAN), 2021, pp. 1-5, doi: 10.1109/ICSCAN53069.2021.9526393.
- S. T. Ratnaparkhi, A. Tandasi and S. Saraswat, "Face Detection and Recognition for Criminal Identification System," 2021 11th International Conference on Cloud Computing,Data Science & Engineering (Confluence), 2021, pp. 773-777, doi:10.1109/Confluence51648.2021.9377205.
- S. Mane and S. Mangale, "Moving Object Detection and Tracking Using Convolutional Neural Networks," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), 2018, pp.1809-1813, doi: 10.1109/ICCONS.2018.8662921.

Appendix C: Traceability Matrix

[Demonstrate the forward and backward traceability of the system to the functional and non-functional requirements documented in the Requirements Document.]

Project Requirement Specification Reference Section No. and Name.	DESIGN / HLD Reference Section No. and Name.
4. High Level Design	6. Activity Diagram
4.1 Model 1	7. User Interface Diagram
4.2 Model 2	7.1 Use Case Diagram
5.1 Class Diagram	9 External Interface