VIRTUALEYE - LIFE GUARD FOR SWIMMING POOLS TO DETECT ACTIVE DROWNING

PROJECT REPORT

Submitted by

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

Swimming is one of the best exercises that helps people to reduce stress in this urban lifestyle. Swimming pools are found larger in number in hotels, and weekend tourist spots and barely people have them in their house backyard. Beginners, especially, often feel it difficult to breathe underwater which causes breathing trouble which in turn causes a drowning accident. By studying body movement patterns and connecting cameras to artificial intelligence (AI) systems we can devise an underwater pool safety system that reduces the risk of drowning. Usually, such systems can be developed by installing more than 16 cameras underwater and ceiling and analyzing the video feeds to detect any anomalies. but AS a POC we make use of one camera that streams the video underwater and analyses the position of swimmers to assess the probability of drowning, if it is higher then an alert will be generated to attract lifeguards' attention.

1.2 PURPOSE

Worldwide, drowning produces a higher rate of mortality without causing injury to children. Children under six of their age are found to be suffering the highest drowning mortality rates worldwide. Such kinds of deaths account for the third cause of unplanned death globally, with about 1.2 million cases yearly.

To overcome this conflict, a meticulous system is to be implemented along the swimming pools to save human life.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

REF	DATASET	TECHNIQUE	SOFTWARE MODEL	TESTING ACCURACY
[1]	A Novel method for recognition, Localisation and alarming to prevent swimmers from drowning	Feed forward Neural Network to aid the acoustic simulator in analysis of distance of the swimmer	TensorFlow, object detection model	Better accuracy levels with the help of identification of the swimmer's 3D position
[2]	Drowning Detection Algorithm For Intelligent Lifebuoy	An improved YOLOV4 network is detect the drowning person and a geometric distance measurement method based on the bounding box to detect position.	TensorFlow, object detection model Zoo	88% with a scan time of 1.5 seconds

[3]	An Improved Detection Method of Human Target at Sea Based on Yolov3	Object detection technology,an improved Yolov3 algorithm aided with feature extraction network	Relu, Soft Max	The detection accuracy of the improved algorithm for human targets at sea is 72.17%, which has a good detection effect
[4]	Intelligent Swimming-pool design with Embedded Drown Alerting, Preventing and Autonomous Rescue System	A combination of an elevator housing array of Proximity-sensors and deep learning methodologies is used	CNN	The performance of the prototype is satisfactory and giving promising results
[5]	Computer Vision Enabled Drowning Detection System	Using convolutional neural network (CNN) models, it can detect a drowning person in different stages	CNN	A higher degree of accuracy is achieved by identifying the swimmer's 3D position.

Table. 2.1-Literature Survey

2.2 REFERENCES

[1] H. Liu, M. B. H. Frej and B. Wen, "A Novel Method for Recognition, Localization, and Alarming to Prevent Swimmers from Drowning," 2019 IEEE Cloud Summit, 2019, pp. 65-71, doi: 10.1109/CloudSummit47114.2019.00017.

[2] D. Yang, Y. Cao, Y. Feng, X. Lai and Z. Pan, "Drowning Detection Algorithm For Intelligent Lifebuoy," 2021 IEEE International Conference on Unmanned Systems (ICUS), 2021, pp. 512-519, doi: 10.1109/ICUS52573.2021.9641291.

[3] D. Li, L. Yu, W. Jin, R. Zhang, J. Feng and N. Fu, "An Improved Detection Method of Human Target at Sea Based on Yolov3," 2021 IEEE International Conference on Consumer Electronics and Computer Engineering (ICCECE), 2021, pp. 100-103, doi: 10.1109/ICCECE51280.2021.9342056.

[4] P. Laxman and A. Jain, "Intelligent Swimming-pool design with Embedded Drown Alerting, Preventing and Autonomous Rescue System," 2021 Fourth International Conference on Computational Intelligence and Communication Technologies (CCICT), 2021, pp. 335-342, doi: 10.1109/CCICT53244.2021.00069.

[5] U. Handalage, N. Nikapotha, C. Subasinghe, T. Prasanga, T. Thilakarthna and D. Kasthurirathna, "Computer Vision Enabled Drowning Detection System," 2021 3rd International Conference on Advancements in Computing (ICAC), 2021, pp. 240-245, doi: 10.1109/ICAC54203.2021.9671126.

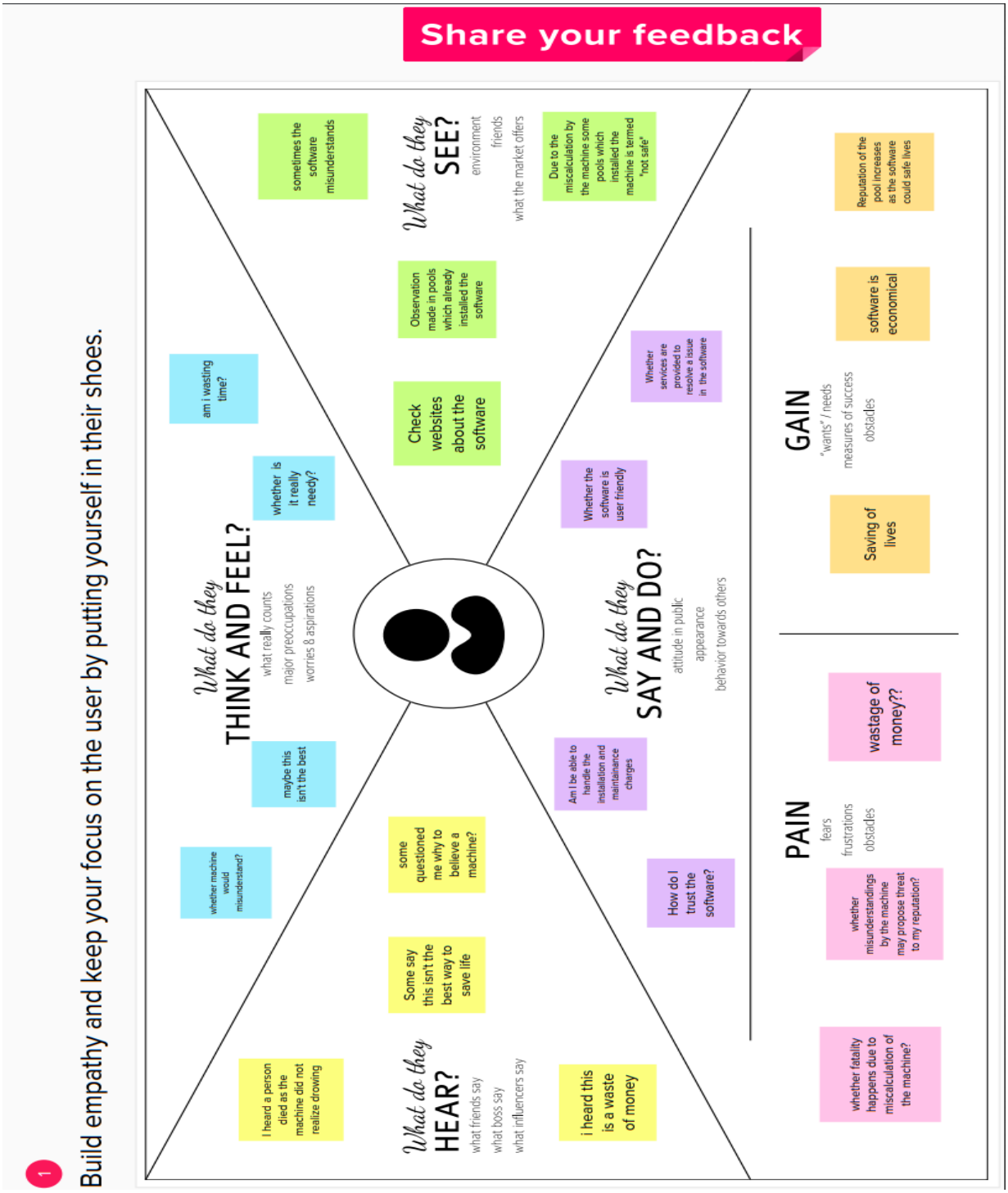
2.3 PROBLEM STATEMENT DEFINITION

The best exercise for lowering stress in this urban lifestyle is swimming. Hotels and weekend tourist destinations are where you'll find swimming pools in greater numbers; rarely do you see people with pools in their backyards. Beginners, in particular, frequently find it challenging to breathe underwater. Breathing issues lead to accidents where people drown because of inability to breathe. A higher mortality rate without harm to children is produced by drowning globally. They are found to have the highest global drowning mortality rates among children under six years of age. With about 1.2 million cases each year, these types of deaths rank third among all unplanned deaths worldwide.

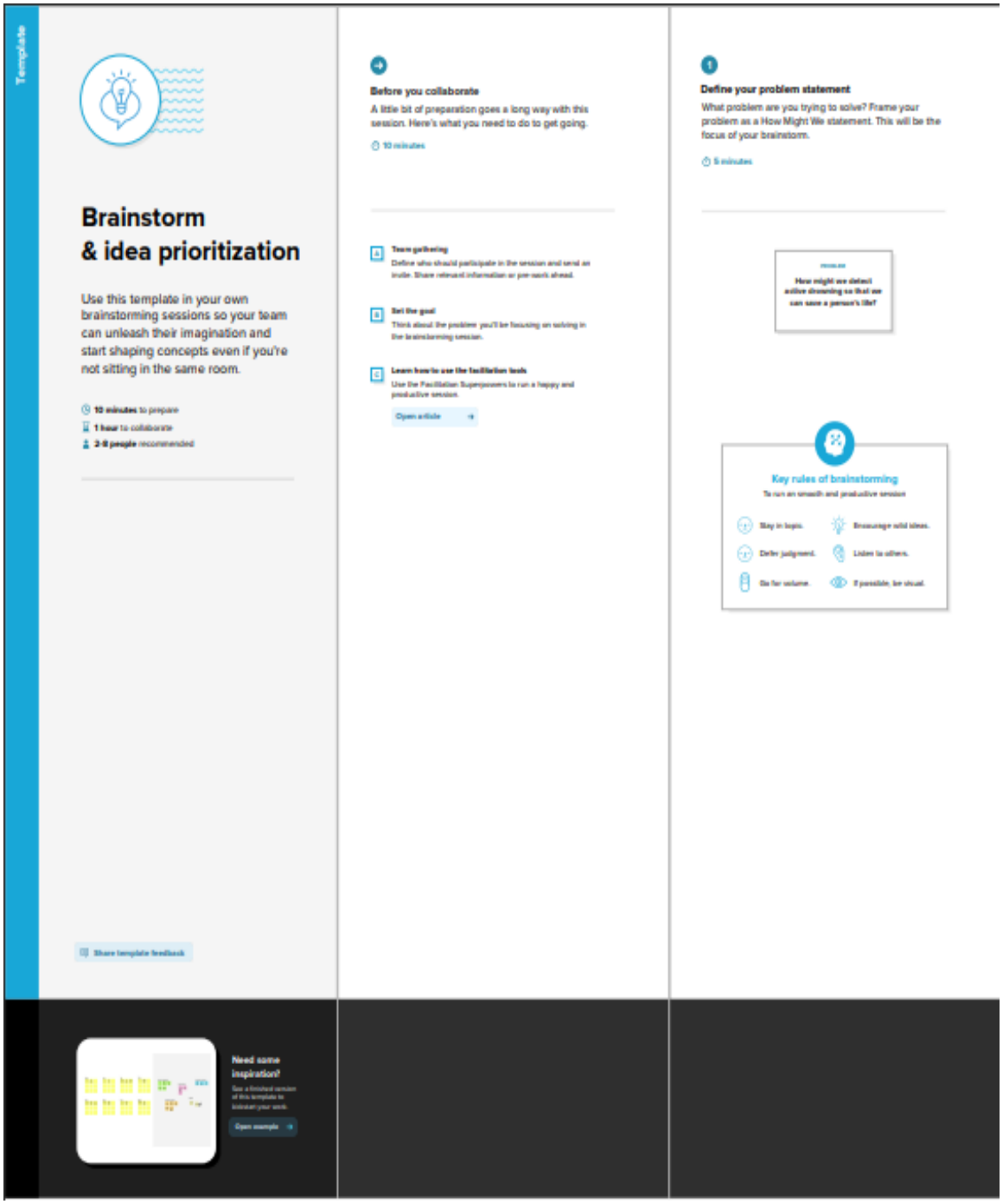
A meticulous system must be put in place along the swimming pools to save human life in order to resolve this conflict.We can design an underwater pool safety system that lowers the risk of drowning by analysing body movement patterns and integrating cameras with artificial intelligence (AI) systems. Such systems are typically created by mounting more than 16 cameras underwater and on the ceiling, then reviewing the video feeds to look for any irregularities. However, as a POC, we employ a single camera that streams underwater video while analysing swimmer positioning to determine the likelihood of drowning; if it is higher, an alert will be generated to draw lifeguards' attention.

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION & BRAINSTORMING



2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Ashreen Benazir K

Nivisha R

Madhuchandha P

Reshmi Harshitha B

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

Camera

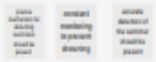
Emergency

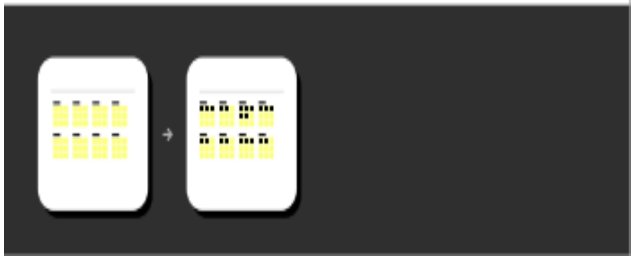
Alarm

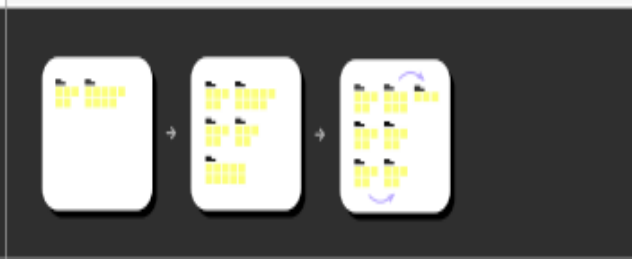
Software

Lifegaurd

Drowning







4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

Importance

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

5

After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

Share the mural
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

Export the mural
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.
Open the template →

Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.
Open the template →

Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template →

Share template feedback

3.3 PROPOSED SOLUTION

S.NO.	PARAMETER	DESCRIPTION
1.	Problem Statement (Problem to besolved)	Swimmers in the pool are detectedusing an overhead camera. First, swimmers in the pool aredetected using an overhead camera First, swimmers in the pool are detected using an overhead camera People visit the swimming pools to practice or to learn swimming. There is a possibility of someone drowning as they are new to these activities. So to detect the active drowning of the person, our "Virtual Eye" program is installed in the security cameras available in the swimming pool, and it detects an alarm, and thus alerting the lifeguards about the drowning. Thus a meticulous system is to be implemented along the swimming pools to save human life. By studying body movement patterns and connecting cameras to artificial intelligence (AI) systems we can devise a pool safety system that reduces the risk of drowning.

2.	Idea / Solution description	The proposed system makes a novel attempt to evaluate swimmers' conditionsby analysing their motion and shape features via visual based monitoring device and an alarm to alert, and providessolutions in detecting drowning incidents. While challenging in many aspects, a successful system will bring inestimablevalue in saving human lives.
3.	Novelty / Uniqueness	Virtual eye has developed a novel idea of alerting the ambulance and another lifeguard if there is any delay in saving theperson to death.
4.	Social Impact / Customer Satisfaction	Safety in water has been a concern for many centuries for the survival of humanlives.No matter how watchful and dedicated lifesavers are, they are also humans. It'simpossible for them to monitor every swimmer in a pool, at every minute. But it's vital to reach a drowning victimbefore it's too late and every second counts.

5.	Business Model (Revenue Model)	There are many products currently available in this regard. Our solution, once developed well, has enough possibility to become a good product to save drowning victims.
6.	Scalability of the Solution	Our proposed solution is very scalable i.e., in future, there are a lot of rooms for evolving our present model by adding new features to enhance our system in thefuture

3.4 PROBLEM SOLUTION FIT

Problem-Solution Fit canvas — VIRTUAL EYE - LIFE GUARD FOR SWIMMING POOLS TO DETECT ACTIVE DROWNING (PNT2022TMID23045)

Define CS, fit into CL

1. CUSTOMER SEGMENT(S) — CS

Persons who swim in a pool are goint to be constantly kept an eye over them by a visual based monitoring system

6. CUSTOMER LIMITATIONS EG. BUDGET, DEVICES — CL

--> Constant network connection
-->Camera misunderstandig normal swimming action to be abnormal
-->Cost of fitting and maintainance

5. AVAILABLE SOLUTIONS PROS & CONS — AS

-->Setting up of a camera and monitoring each and every person swimming in the pool Setting an alarm to notify the lifeguard
-->Detects and prevents active drowning

Explore AS, differentiate

Focus on PR, tap into BE, understand RC

2. PROBLEMS / PAINS + ITS FREQUENCY — PR

-->People visit the swimming pools to practice or to learn swimming. There is a possibility of someone drowning as they may be new to these activities.

-->Exisiting visual based monioring systems too economical to be adopted by every needed environment

Such kinds of deaths account for the third cause of unplanne d death globally, with about 1.2 million cases yearly.

9. PROBLEM ROOT / CAUSE — RC

-->People think that the camera that is set up to monitor the persons who are swimming are of no proper and accurate use

-->Anticipation over all the other system happens when one device fails to do its service

7. BEHAVIOR + ITS INTENSITY — BE

-->The customer believes more in a manual monitoring system rather than a visual monitoring system

-->He/She wants to be always surrrounded by a lifeguard rather being monitored by a camera

The customer will exhibit this behaviour until an aunthenti -cated application serves its purpose rightly

Focus on PR, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TO ACT — TR

-->The customer is triggered by their surrounding talking about this approach of detecting and preventing active drowning
-->Economical installation cost also plays a pivotal role

4. EMOTIONS BEFORE / AFTER — EM

BEFORE:
-->Fear of unprotected swimming
AFTER:
-->Fearless and satisfactory swimming experience

10. YOUR SOLUTION — SL

-->The proposed system makes a novel attempt to evaluate swimmers conditions by analysing their motion and shape features via visual based monitoring device and an alarm to alert, and provides solutions in detecting drowning incidents.

-->While challenging in many aspects, a successful system will bring inestimable value in saving human lives.

8. CHANNELS of BEHAVIOR — CH

ONLINE

-->Devolop an application and provide all sort of assistance to the users regarding the virtual eye

OFFLINE

-->Provide quality safetywears while swimming

Extract online & offline CH of BE

IdeaHackers.NL

4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Following are the functional requirements of the proposed solution.

FR NO.	FUNCTIONAL REQUIREMENT (EPIC)	SUB REQUIREMENT (STORY / SUB-TASK)
FR-1	**User Registration**	User should register his/her information in the application
FR-2	**User Confirmation**	User gets a verification mail for the first time he/she signs up
FR-3	**Installation of camera**	A camera is installed above the surface ofthe water to constantly monitor all the persons swimming in the pool to detect active drowning
FR-4	**Setting up an alarm**	An alarm is set to alert the lifeguard in case of detection of active drowning
FR-5	**Diff erentiation betweentones**	Diff erence between alarm tones are set to detect drowning of people from diff erent age groups
FR-6	**Emergency**	Alerting another lifeguard and an ambulance in case of emergency

4.2 NON-FUNCTIONAL REQUIREMENTS

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

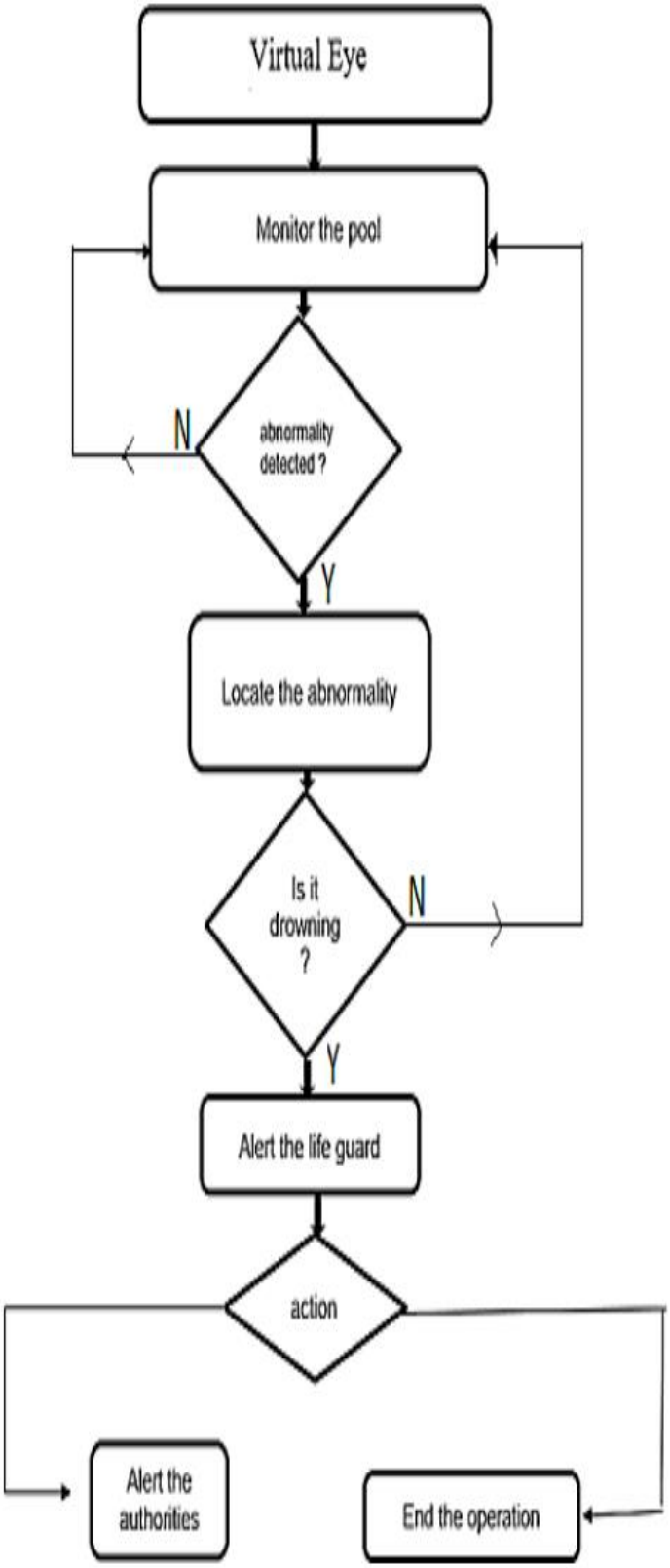
FR NO.	NON-FUNCTIONAL REQUIREMENT	DESCRIPTION
NFR-1	**Usability**	Everyone should be able to understand the UI and find the necessary informationwithout the need for any specialised training. Depending on the needs, various languages can be provided.
NFR-2	**Security**	The system will keep all footage it recordsprivate and secure from unauthorised access. Any footage would only be accessed with prior approval during an investigation.
NFR-3	**Reliability**	The system's incident reporting is very accurate. Once it is installed, the only waythe system could malfunction is if routine maintenance is neglected.
NFR-4	**Performance**	With a rapid response time, the system'sperformance is determined by how quickly the lifeguard responds to the alarm without any latency.

NFR-5	**Availability**	The System should remains operational allthe time and must be recovered within anhour or less if it fails. The system should continue to work seamlessly without any hitch..The system should respond to the requests as soon as possible.
NFR-6	**Scalability**	The system should handle a growing amount of work by adding additional resources to the system in future. The system can also be installed in a variety oflocations, including public schools, workplace complexes, and large open Spaces if needed.

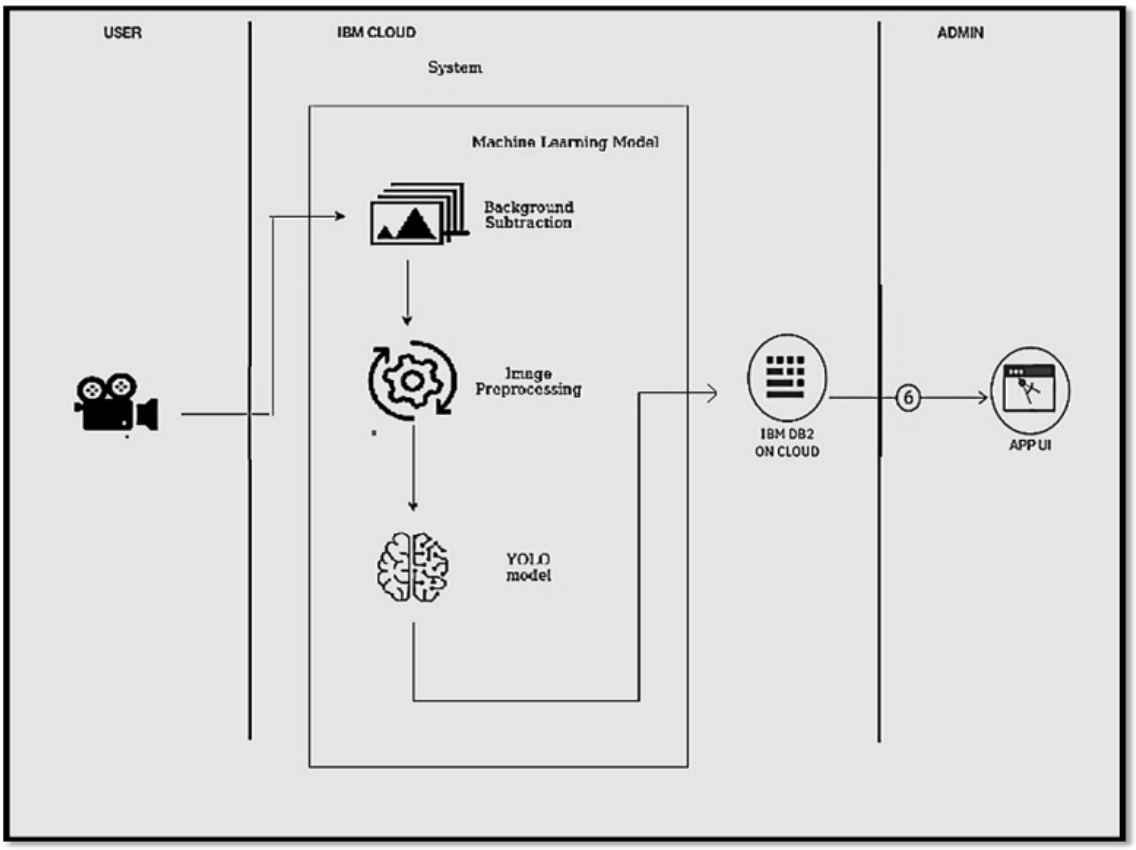
5. PROJECT DESIGN

5.1 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. A data flow diagram (DFD) is a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement. They are often elements of a formal methodology such as Structured Systems Analysis and Design Method (SSADM).


Virtual Eye
Monitor the pool
abnormality detected ?
N
Y
Locate the abnormality
Is it drowning ?
N
Y
Alert the life guard
action
Alert the authorities
End the operation

5.2 SOLUTION & TECHNICAL ARCHITECTURE



S.NO	COMPONENT	DESCRIPTION	TECHNOLOGY
1.	User Interface	Using WebUI, the admin interacts	HTML, CSS,
2.	Background Subtraction	Remove background information to focus onthe subject.	Python
3.	Image preprocessing	putting filters on a picture to make it clearer.	OpenCV
4.	YOLO	To detect drowning, a pre-trained model withfine tuning is used.	Python, TensorFlow

5.	Cloud Database	Database Service on Cloud	IBM Cloudant etc
6.	External AP	the reason for using an external API in theapplication.	Local Filesystem
7.	Video Camera	Live updates from the pool.	Camera.

Table-1 : Components & Technologies

S.NO	CHARACTERISTICS	DESCRIPTION	TECHNOLOGY
1.	Open-Source Frameworks	TensorFlow,OpenCV2	Technology of Opensource framework
2.	Security Implementations	IBM Cloud Security Measures	e.g. SHA-256, Encryptions, IAM Controls, OWASPetc.
3.	Availability	Available at all times.	IBM Cloud Server
4.	Performance	Use of Cache to store frames	High performance cameras

Table-2: Application Characteristics

5.3 USER STORIES

USER TYPE	FUNCTIONAL REQUIREMENT(EPIC)	USER STORY NUMBER	USER STORY/ TASK	ACCEPTANCE CRITERIA	PRIORITY	RELEASE
Customer / Pool Owner Primary user	Installation	USN-1	As a user, I believe Virtual eye has created more security in the pool , Incase of any accidents it can provide fast response to the problem. As a owner I , more customers come to the pool due to increased security.	I can install this system and save myself also other swimmers from any accidents that may occur in the pool.	High	Sprint-1

Lifeguard Secondary User	User	USN-2	As an user ,I would receive alertsfrom the system to rescue victims. I will immediately alert the authorities in case of critical situations also rescue thehelpless victims from losing their lives.	I can receive alerts from the system in case there are any potential drowners , amateur swimmers can be saved from critical situations.	High	Sprint-1
Swimmer Tertiary User	Rescuing	USN-3	As a user,I am thankful to the systemfor alerting the lifeguard on duty at the right time.	I can swim freely knowing that if I were to potential ly drown, VirtualE ye will alert the lifeguard to save me.	Low	Sprint-2

6. PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Installation	USN-1	I can install this system and save myself also other swimmers from any accidents that may occur in the pool.	2	High	ReshmiHarshitha B, Madhuchandha P
Sprint-1	User	USN-2	I can receive alerts from the system in case there are any potential drowners , amateur swimmers can be saved from critical situations.	1	High	Aafreen Benazir K , Nivisha R

Sprint-2	Rescuing	USN-3	I can swim freely knowing that if I were to potentially drown, VirtualEye will alert the lifeguard to save me.	2	Low	Madhuchandha P
Sprint-3	Notification	USN-6	As a User,I can get the notification about Drowning	2	High	Nivisha R
Sprint - 4	Save a Life	USN-7	As a User,I can get help from the Lifeguard	2	High	Aafreen Benazir K , Reshmi Harshitha B

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on PlannedEndDate)	Sprint ReleaseDate (Actual)
Sprint-1	20	6 Days	24 Oct2022	29 Oct2022	20	29 Oct2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov2022	20	05 Nov2022
Sprint-3	20	6 Days	07 Nov2022	12 Nov2022	20	12 Nov2022
Sprint-4	20	6 Days	14Nov 2022	19Nov 2022	20	19Nov 2022

7.CODING & SOLUTIONING

```
import cv2,os

data_path='dataset'
categories=os.listdir(data_path)
labels=[i for i in range(len(categories))]

label_dict=dict(zip(categories,labels))

print(label_dict)
print(categories)
print(labels)

img_size = 100
data = []
target = []

for category in categories:
    folder_path = os.path.join(data_path, category)
    img_names = os.listdir(folder_path)

    for img_name in img_names:
        img_path = os.path.join(folder_path, img_name)
        img = cv2.imread(img_path)
```

Sample coding-1

```
from keras.models import Sequential
from keras.layers import Dense,Activation,Flatten,Dropout
from keras.layers import Conv2D,MaxPooling2D
from keras.callbacks import ModelCheckpoint

model=Sequential()

model.add(Conv2D(200,(3,3),input_shape=data.shape[1:]))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2,2)))


model.add(Conv2D(100,(3,3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2,2)))


model.add(Flatten())
model.add(Dropout(0.5))

model.add(Dense(50,activation='relu'))

model.add(Dense(2,activation='softmax'))
```

Sample coding-2

```
import cvlib as cv
from cvlib.object_detection import draw_bbox
import cv2
import time
import numpy as np
from playsound import playsound
import requests
from flask import Flask, request, render_template, redirect, url_for
#loading the model

from cloudant.client import Cloudant
```

Sample Coding 3

```python
@app.route('/afterreg', methods=['POST'])
def afterreg():
    x = [x for x in request.form.values()]
    print(x)
    data = {
    '_id': x[1], # Setting _id is optional
    'name': x[0],
    'psw':x[2]
    }
    print(data)

    query = {'_id': {'$eq': data['_id']}}

    docs = my_database.get_query_result(query)
    print(docs)

    print(len(docs.all()))

    if(len(docs.all())==0):
        url = my_database.create_document(data)
        #response = requests.get(url)
        return render_template('register.html', pred="Registration Successful, please login using your details")
    else:
        return render_template('register.html', pred="You are already a member, please login using your details")
```

Sample Coding 4

```python
#login page
@app.route('/login')
def login():
    return render_template('login.html')

@app.route('/afterlogin',methods=['POST'])
def afterlogin():
    user = request.form['_id']
    passw = request.form['psw']
    print(user,passw)

    query = {'_id': {'$eq': user}}

    docs = my_database.get_query_result(query)
    print(docs)

    print(len(docs.all()))


    if(len(docs.all())==0):
        return render_template('login.html', pred="The username is not found.")
    else:
        if((user==docs[0][0]['_id'] and passw==docs[0][0]['psw'])):
            return redirect(url_for('prediction'))
        else:
            print('Invalid User')
```

Sample Coding 5

```
@app.route('/result',methods=["GET","POST"])
def res():
    webcam = cv2.VideoCapture('drowning.mp4')

    if not webcam.isOpened():
        print("Could not open webcam")
        exit()

    t0 = time.time() #gives time in seconds after 1970

    #variable dcount stands for how many seconds the person has been standing still for
    centre0 = np.zeros(2)
    isDrowning = False

    #this loop happens approximately every 1 second, so if a person doesn't move,
    #or moves very little for 10seconds, we can say they are drowning

    #loop through frames
    while webcam.isOpened():
        # read frame from webcam
        status, frame = webcam.read()
```

Sample coding 6

8.TESTING

8.1 TEST CASES

8.2 USER ACCEPTANCE TESTING

User Acceptance Testing (UAT) is a type of testing performed by the end user or the client to verify/accept the software system before moving the software application to the production environment. UAT is done in the final phase of testing after functional, integration and system testing is done.

9. RESULTS

9.1 PERFORMANCE METRICS

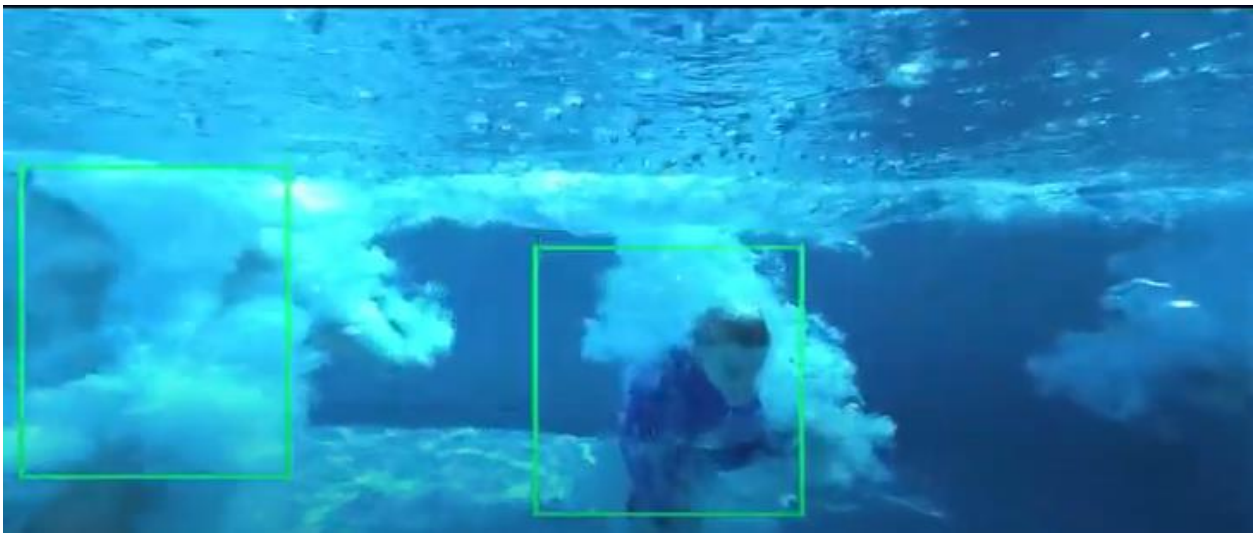
```
99/99 [==============================] - 261s 3s/step - loss: 0.3300 - accuracy: 0.8417 - val_loss: 0.2731 - val_accuracy: 0.8412
Epoch 2/20
99/99 [==============================] - 247s 2s/step - loss: 0.2201 - accuracy: 0.9081 - val_loss: 0.1642 - val_accuracy: 0.9352
Epoch 3/20
99/99 [==============================] - 206s 2s/step - loss: 0.1682 - accuracy: 0.9352 - val_loss: 0.1638 - val_accuracy: 0.9263
Epoch 4/20
99/99 [==============================] - 198s 2s/step - loss: 0.1167 - accuracy: 0.9530 - val_loss: 0.1426 - val_accuracy: 0.9479
Epoch 5/20
99/99 [==============================] - 195s 2s/step - loss: 0.0957 - accuracy: 0.9641 - val_loss: 0.1518 - val_accuracy: 0.9365
Epoch 6/20
99/99 [==============================] - 194s 2s/step - loss: 0.0661 - accuracy: 0.9730 - val_loss: 0.1461 - val_accuracy: 0.9441
Epoch 7/20
99/99 [==============================] - 193s 2s/step - loss: 0.0501 - accuracy: 0.9816 - val_loss: 0.1511 - val_accuracy: 0.9390
Epoch 8/20
99/99 [==============================] - 195s 2s/step - loss: 0.0394 - accuracy: 0.9851 - val_loss: 0.1057 - val_accuracy: 0.9606
Epoch 9/20
99/99 [==============================] - 192s 2s/step - loss: 0.0357 - accuracy: 0.9889 - val_loss: 0.1101 - val_accuracy: 0.9593
Epoch 10/20
99/99 [==============================] - 195s 2s/step - loss: 0.0245 - accuracy: 0.9924 - val_loss: 0.0907 - val_accuracy: 0.9682
Epoch 11/20
99/99 [==============================] - 206s 2s/step - loss: 0.0262 - accuracy: 0.9914 - val_loss: 0.1267 - val_accuracy: 0.9543
Epoch 12/20
99/99 [==============================] - 212s 2s/step - loss: 0.0184 - accuracy: 0.9917 - val_loss: 0.1349 - val_accuracy: 0.9644
```

Epoch results-1

```
Epoch 13/20
99/99 [==============================] - 198s 2s/step - loss: 0.0455 - accuracy: 0.9806 - val_loss: 0.1533 - val_accuracy: 0.9581
Epoch 14/20
99/99 [==============================] - 197s 2s/step - loss: 0.0192 - accuracy: 0.9949 - val_loss: 0.1177 - val_accuracy: 0.9670
Epoch 15/20
99/99 [==============================] - 198s 2s/step - loss: 0.0236 - accuracy: 0.9908 - val_loss: 0.0969 - val_accuracy: 0.9657
Epoch 16/20
99/99 [==============================] - 215s 2s/step - loss: 0.0085 - accuracy: 0.9978 - val_loss: 0.1116 - val_accuracy: 0.9670
Epoch 17/20
99/99 [==============================] - 229s 2s/step - loss: 0.0101 - accuracy: 0.9959 - val_loss: 0.1130 - val_accuracy: 0.9695
Epoch 18/20
99/99 [==============================] - 207s 2s/step - loss: 0.0099 - accuracy: 0.9978 - val_loss: 0.1373 - val_accuracy: 0.9657
Epoch 19/20
99/99 [==============================] - 202s 2s/step - loss: 0.0223 - accuracy: 0.9921 - val_loss: 0.1417 - val_accuracy: 0.9543
Epoch 20/20
99/99 [==============================] - 207s 2s/step - loss: 0.0319 - accuracy: 0.9889 - val_loss: 0.1128 - val_accuracy: 0.9733
```

Epoch results-2

OUTPUT



10. ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- These visual monitoring systems make much of a positive contribution. It provides a way for the earliest detection of drowning persons through alarms
- It also serves for an easy installation in swimming pools
- Installation of camera(virtual eye) in the swimming pools are not so expensive
- Low maintenance of the installed camera

DISADVANTAGES

- Although it offers certain benefits, there are some drawbacks as well. There is a possibility of machine misunderstanding the situations
- Requirement of manual monitoring even though visual systems are placed

11. CONCLUSION

These visual monitoring systems significantly improve things. Through alarms, it offers a method for the quick identification of drowning victims. Additionally, it facilitates simple installation in swimming pools. The cost of installing cameras (virtual eyes) in swimming pools is not very high. Low upkeep for the installed camera is only required. Although , The likelihood of a machine misinterpreting the circumstances exists. Even though there are visual systems in place, manual monitoring is still necessary. They serve the best for saving of lives with no latency