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Accident Emergency Notification System

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Abstract: This paper introduces the concept of an "Accident Emergency Notification System (AENS)" designed for improving the process of accident reporting. Timely accident reporting is vital for saving lives, and AENS serves as a dedicated platform to facilitate immediate accident notifications while ensuring an organized work flow. It addresses key challenges, such as notifying the accident victim's family, retrieving vehicle insurance information, and providing essential personal details to assist the law enforcement agencies in managing the situation. Accident Emergency Notification System(AENS) integrates various technologies such as QR code generation, incident reporting, and real-time communication, RCNN (Region based Convolutional Neural Network) which is used to predict whether accidents occurred or not, Further the intimation is sent to medical services, family and insurance agencies about the accident.
Keywords: QRCode; Incident Reporting; Emergency Response; Road Safety; Real-Time Data; User Engagement; Technology Integration, RCNN.

I.INTRODUCTION

An unexpected incident that happens unintentionally, often without warning that can cause harm, injury, or damage is termed an accident. There are different classifications and categories in accidents, of which some are railway accidents, industrial accidents, road traffic accidents, domestic accidents, medical accidents, and so on. Out of these accidents, the major happening accidents are road accidents. This happens due to multiple reasons, like improper road facilities, which can lead to high fatalities, and emergency care service delays. No centralized dashboard or platform has reliable information about the ambulance number, distribution, and ownership of whether it is a private vehicle or public vehicle. If the vehicle is not registered, it can increase the reporting time at the accident scene after the emergency call is made. In adequate facilities in ambulances can cause significant treatment disadvantages [2]. In an era where road traffic accidents claim thousands of lives, a study published on the 2019 National Emergency Medical Service Information System revealed that out of 654,675 persons involved in EMS (Emergency Medical Services)-activated road crash events, ETT (EMS Travel Time) delays can significantly increase the odds of DAS (Deaths at crash scene) by 34% [1].So, it is crucial to have a dedicated platform to address this issue. When an accident takes place, during critical hours the importance of reporting the accident has the same importance as of treating the patient with proper medications in that time. In this busy running world, people are keen on capturing the incident to use the photos as their content for their purpose, rather than calling the ambulance to inform about the accidents to save the life of the victim(s), but with the technology and developments in the current era it can be advanced according to people's interest by just capturing the images of accident to submit through scanning QR code which makes the reporting easy and quick, which also minimize the delayed accident reporting time . This QR code has vast applications in many fields such as healthcare, transportation, retailing, manufacturing which helps in easy identifying, tracking and locating the items in the mentioned fields and it is a swift response technology because one can just show their camera to the code and it redirects in seconds to the purpose of what it is being designed.

II. RELATED WORKS

An article published on National Library of Medicine [US] has shown a cross-sectional analysis on association of crash response times and deaths at the crash scene. Emergency Medical Services (EMS) – activated accidents are the accident which needs immediate attention of medical services in the accident scene. This article highlights the importance of reaching the accident spot and treating the victim at the earliest can decrease the chances of Death at the crash Scene (DAS).

The NEMSIS (National Emergency Medical Services Information System) 2019 data, which has the census of EMS-activations across US, is utilized for the study of this article. It tells show EMS Chute Initiation Time (ECIT) and EMS Travel Time (ETT) delays can increase the odds of DAS.

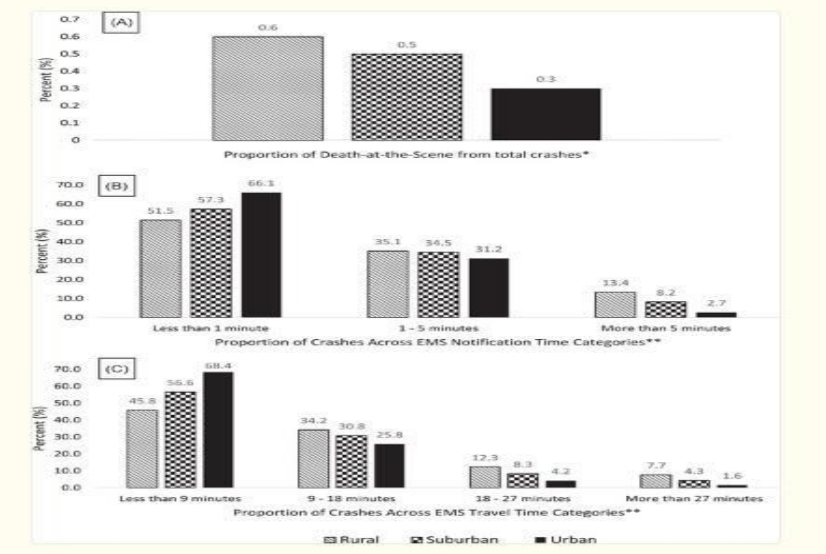

Fig1. Graph of DAS statistics

The research focused on two accidents that took place in different types of areas urban, suburban, and rural and examined the role of EMS in affecting DAS. The study specifically analyzed rush hours (6-9 am, 3-7 pm) and off-peak hours.TheFig1showsthe graphs of how DAS proportioned in accident scene, due to delay of ECIT, and ETT delay respectively. This study focused on improving the EMS to decrease the odds of DAS [1]. Automatic Accident Detector and Reporting System (Hardware and Software) ECBA Medical System, aims in telling the importance of saving life of a victim in the accident spot by public .The primary components of the system are a hardware system with accident detecting sensors, a kit which contains first aid tools, and the users with the mobile application and medical kit gets notified. It aims in giving basic first aid to the victim by sending a notification to the person who is already registered in the application developed and has medical kit. The goal is to preserve life by providing immediate assistance until the medical team arrives at the scene of the accident. On detection of accident, the sensors send signal to application via Bluetooth which sends a notification to the nearest people with the app with the live location of the accident spot. On accepting the notification request, people can drive to the spot and give medical care under medical assistance until the professionals arrive [3]. A paper for Accident Detection using Images and Videos with Convolutional Neural Network (CNN), Long Short Term Memory (LSTM), and Interpreting the Results using LIME & Grad CAM explores the use of Convolutional neural network and Region based convolutional neural network. It mainly focuses on the image and video detection in the area of accident. It uses CCTV video footage and images of accident for processing the image and videos detection using CNN. The results show that CNN is best in its accuracy of detecting images and it is very effective for real-time safety enhancement and accident detection [7]. “Vehicle accident detection and Notification system” aims in the area of accident by integrating sensors for monitoring the vehicle crashes and movements. To analyze the sensor data, a crash detection algorithm is used, and Global Positioning System (GPS) is used for tracking the vehicles exact location. And it also integrates Signal processing and machine learning to analyze data, which helps in reducing false alarms. Upon the detection of crash, the system sends notification to the monitoring stations or contacts designated with the occupant details via satellite or cellular communication [10].

III. TECHNOLOGY USED

A. Quick Response codes(QR Codes):

QR codes are recognized for its best way of concealing information securely in the open internet, and its quick access to information makes it even more attractive to adapt the technology. A Japanese company DensoWavein1994 invented this Quick Response (QR) codes for tracking vehicles in the process of manufacturing, and it has come to be the most popular 2- dimensional barcode in current technology development [4]. The white and black stripes combination helps the laser to pass on them and decodes the information encoded using it. So we opted for QR codes for accessing information via it. The main reason for only QR codes in our plat form is that its ability to work across different platforms i.e., tablets, laptops, Mobile phones. It requires no complex setup or additional software, user can easily can the QR codes using their mobile phone cameras and by any scanning apps. And it also don’t require any special devices or readers as of NFC, RFID which makes it more ideal for users to use it in priority rather than other techniques. The need for writing very long URL’s is also neutralized here with the use of QR codes.

B. Application Programming Interface(API):

A set of procedures and functions which helps to access information and features for one application in another Application are known as Application Program Interfaces.

They provide an easy way to access information or use features of a particular application in our system. There are different kinds of API's namely Open API's, Partner API's, Internal API's and Composite API's. Of which we in our system integrated API's like...

1 **Twilio OTP:** an external API, which is a communication- based API. It is mainly used for OTP (One-Time Password) generation, OTP sending and for verifying the OTP's. The greatest advantage of using Twilio is that it is a pay-as-you– go model, which the user needs to pay for only what he/she uses. But other API's like nexmo, bandwidth offers basic pricing but they may not be as transparent as Twilio. Twilio also offers two-factor authentication which ensures much security in the internet. It integrates well with python language and its verification is easy and adaptable. It has good authenticity with the phone numbers verification of clients [5].

2 Google Maps API: is also an external API integrated into system which helps in integrating Google maps to our Platform. The data quality and accuracy of Google map API's is very attractive and is widely used by most third-party services and apps (like booking services, transportation apps, delivery apps, etc.). A paper proposed a web based system for attendance monitoring system combined with Google Map API, which highlighted the flexibility of GoogleMap API in its efficiency in selecting location, tracking and accuracy [8].

3 Payment Gateway: To integrate payment functionalities, an external API and a third-party service Payment API is used. It helps in status tracking of the payment, processing payments and helps in managing refunding and managing transactions. Since nowadays many customers are comfortable with using payment gateways to transact money, which also secures information by encrypting it. A study explored on integrating multiple payment gate ways in market place. It shows that system architecture sends payment requests through REST API, and the gateway processes the transaction and the details are stored in MYSQL database [9].

4 Deep Learning: Machine learning involves training machines to learn from data and make decisions without human intervention. Deep learning is a specialized branch of machine learning that utilizes neural networks with multiple layers to address and solve intricate problems. CNN (Convolutional Neural Network) is a deep learning algorithm commonly used for object detection. Known for its high accuracy, CNN is particularly effective for real-time object detection. A paper on CNN for image detection and recognition worked with the MNIST and CIFAR-10 datasets, where CNN achieved an accuracy of 80.1% in object classification [6].

Fig 2 CNN Algorithm

Algorithm: Anomaly Detection in Images using CNN

Input: Images with accident and without accident.

1. ***Data Preprocessing:*** Label and preprocess images, cleaning the data. Let $X=\{x1,x2,...,xn\}X = \{x_1, x_2, ..., x_n\}X=\{x1,x2,...,xn\}$ represent the image set.
2. ***Region Proposal:*** Use Region Proposal Network (RPN) to propose regions $R=\{r1,r2,...,rm\}R = \{r_1, r_2, ..., r_m\}R=\{r1,r2,...,rm\}$, where rj=(x,y,w,h)r_j = (x, y, w, h)rj=(x,y,w,h) are region coordinates.
3. ***Feature Extraction:*** Extract features for each region with CNN: $fj=CNN(rj)f_j = \text{CNN}(r_j)fj=CNN(rj)$.
4. ***Classification & Localization:*** Classify regions and refine bounding boxes: $cj=FC(fj)c_j = \text{FC}(f_j)cj=FC(fj)$, $bj=Reg(fj)b_j = \text{Reg}(f_j)bj=Reg(fj)$.
5. ***Training:*** Train with combined loss: $L=Lcls+LregL = L_{\text{cls}} + L_{\text{reg}}L=Lcls+Lreg$.
6. ***Anomaly Detection***: Detect anomalies by classifying accident regions: $A=\{xi \in X \mid \exists rj \in R, cj=accident\}A = \{x_i \in X \mid \exists r_j \in R, c_j = \text{accident}\}A=\{xi \in X \mid \exists rj \in R, cj=accident\}$.
7. ***Evaluation:*** Use precision, recall, F1-score for model assessment.
8. ***Deployment:*** Deploy for real-time anomaly detection.

Output: The model detects accidents or anomalies in images.

To train the model, source data (consisting of specific images) comes from different places such as online repositories like Google, or real-time image acquisition methods. The collated Internet data along with real time image data will help to build a much diverse and representative training dataset. Images are then preprocessed for optimization in terms of training. Preprocessing activities begin with the resizing of the corresponding images. That refers to changing the size of the image such that all input images are converted into one fixed format. For instance, all images might be resized to 224×224 pixels. Within this process, each image would have identical sizes; thus, they can harmonize with the input layer of the model. Next, de-noising methods are applied onto the images to scrub off noise and all the associated irrelevant artifacts. Some of the noise-reducing techniques used are Gaussian blur and median blur. These have the effect of smoothing an image such that pixel values have fewer variations, hence directing the model's attention on salient features - not nuisance patterns caused by noise. De-noising is very essential as it improves the quality of the features extracted by the model. They apply data augmentation techniques to fight against over fitting, which occurs when a model is too tightly trained on dataset memories. Data augmentation enhances the training dataset by artificially producing transformation onto the original images to give occurrence of changes.

For example, horizontal-flipping, rotation, and brightness changes are within it. Such transformation would produce an array of images set out for the model to explicitly learn more relevant features, improving its generalization ability for unseen data. The ResNet-152 algorithm with application in residual blocks is at the core of the processing of the model. The 152 intermediate layers consist of the residual blocks, which are very important for superior performance in their training process. The residual blocks mitigate the problems of vanishing gradients and exploding gradients that are very common in deep neural networks through skip connections. Skip connections facilitate easy flow of gradients within the network by skipping one or several layers. As a result, the model would be able to extract better representations of the data and reduce the tendency to degenerate performance with increasing depth. When preprocessing is finished, feature extraction will follow. Feature extraction is the phase where relevant characteristics of the image include but are not limited to shapes, textures, and patterns. Processed images would undergo the residual blocks of the ResNet-152 algorithm after feature extraction as the layers worked together to further reduce noise, and refine features, and detect key patterns indicative of an accident .Finally, a classification result is provided by the model as to whether there is an accident or none.

IV. PROPOSED METHODOLOGY

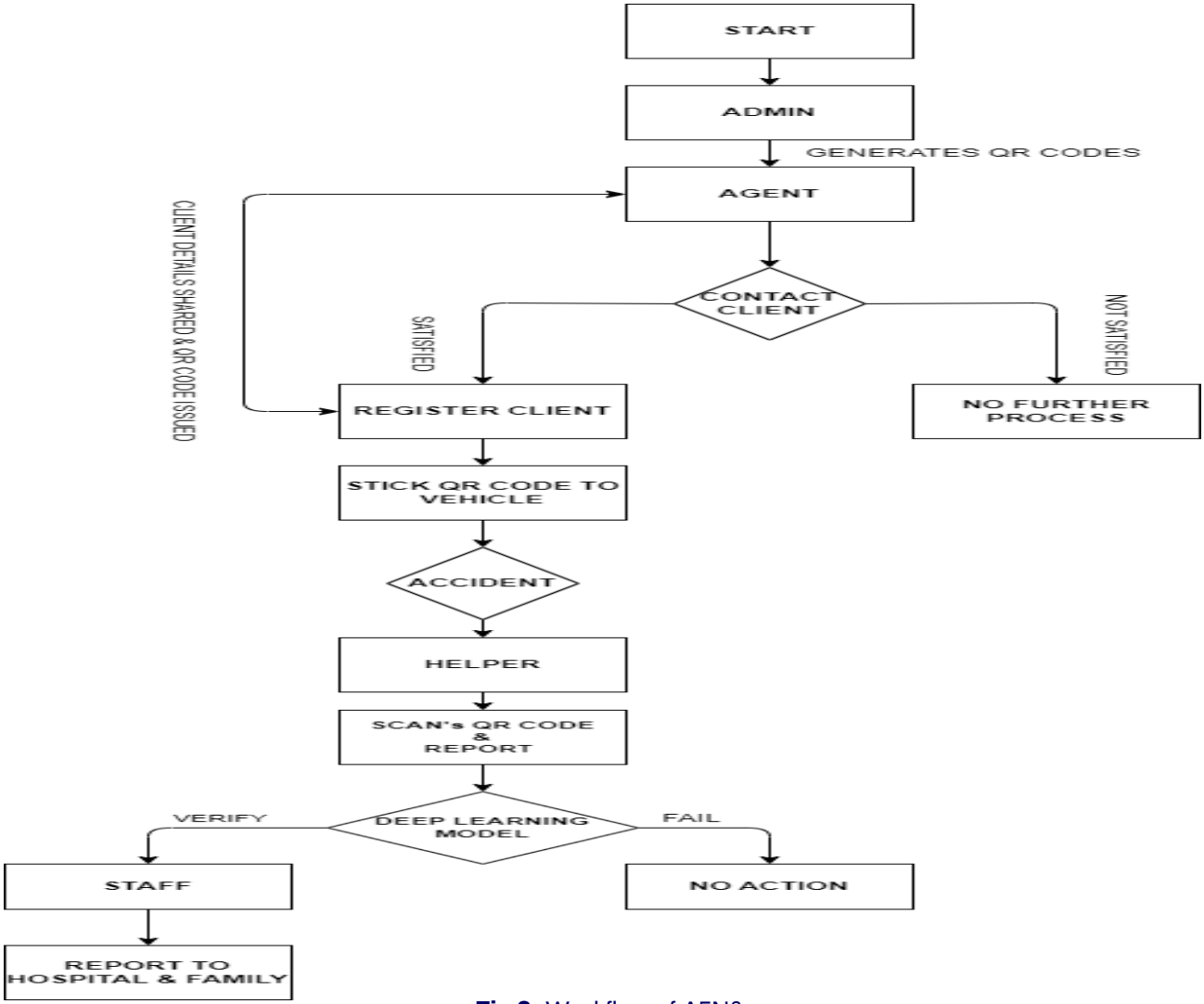

Fig 3. Workflow of AENS

"Accident Emergency Notification System" integrates QR codes for accessing the stored information of the client. Database used for storing and managing the data is MYSQL. The Platform is hosted on cloud server, the main idea behind choosing cloud is its efficiency for remote access, and pay- as-you-go pricing model makes it more attractive. Fig 3.shows the different roles and responsibilities in the platform with the workflow, it includes Admin, Agent, Staff, and Helper. Admin will have centralized dashboard which helps in maintaining and monitoring the whole system efficiently. Admin generates QR codes required for processing. Agent is the one who collects the client data and allots the generated QR code provided by Admin. Then the QR codes are given to the client where he/she can stick it to their vehicles. During an accident, Public person (Helper) scans QR code on the vehicle of the client and an immediate responsive helper form opens and exact live location coordinates are captured using google maps. In that the helper just need to upload the2 image of the accident and name of the helper along with catch and submit it.

This form will be sent to staff, Staff gets immediate personal information about the client whose QR code has been reported. The trained algorithm using CNN ensures that the accident is real. The verified accident will be notified to staff then he/she reports to the nearest hospitals, Family members, law enforcement agencies and insurance company. This real time accident reporting not only helps in faster and efficient treatment to the client but also helps in motivating people to stay alert of the new technologies to be used for reporting. The below figure shows the outcomes of the AENS

V.RESULTS

Fig 4. QR Code Stickers

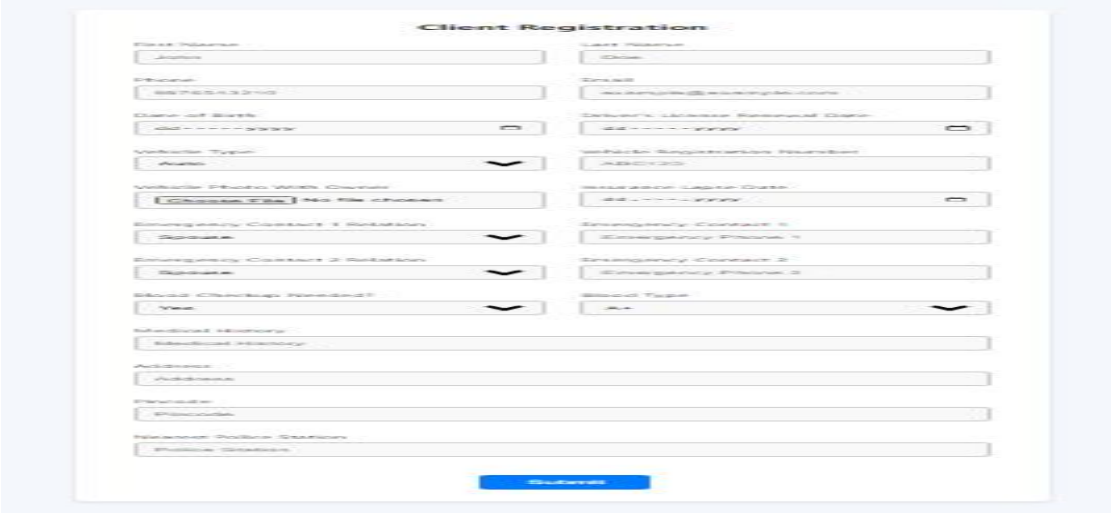

Fig 5. Client Registration Form

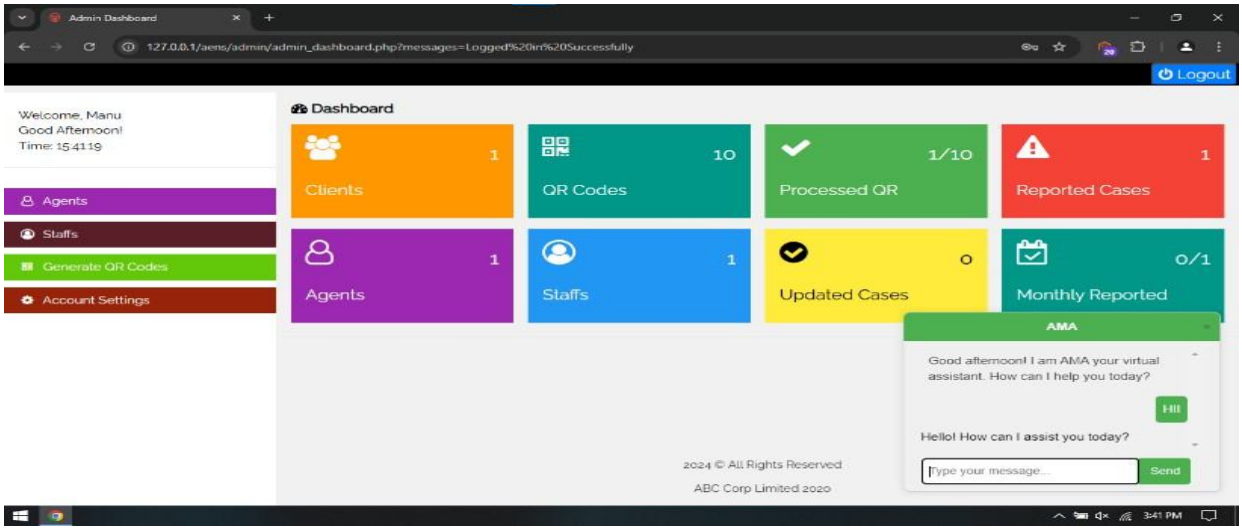

Fig 6. Ask Me Anything (AMA)

Ask Me Anything (AMA) is a Virtual assistant developed and is integrated in AENS platform to fulfill the operational queries. Natural Language Processing (NLP) is a key technology that allows AMA to effectively interpret and respond to user queries with high precision and efficiency. AMA has versatile nature where it can perform across multiple platforms and with API's. Users can engage with AMA anytime from anywhere using their preferred devices.

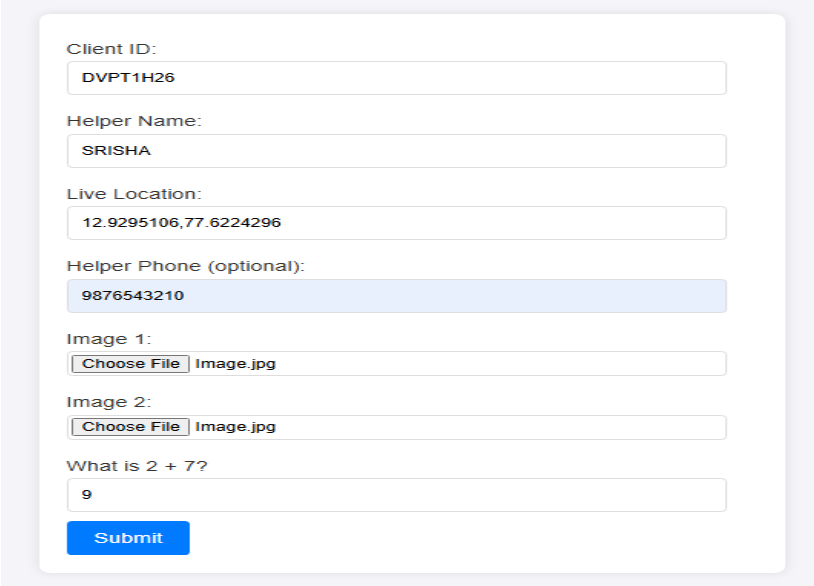

Fig7. Helper Form for reporting accident

V.CONCLUSION

In order to efficiently report an accident, Accident Emergency Notification System (AENS) integrates various technologies like QR Code, API's and Deep learning algorithms. By scanning a QR code on and affected vehicle, helpers can quickly submit accident reports with exact location and pictures of the accident/situation. The system consists of API's like Googlemap, Twilio, Payment gateway for location tracking, communication and payment process. The algorithms are used for analyzing, the images that have been uploaded, to check their genuineness. By combining these advanced technologies AENS demonstrates an innovative and practical approach to accident reporting and emergency management, it significantly reduces response time and improves outcomes in critical scenarios.

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