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Computer Vision in Healthcare Management System Through Mobile Communication

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ABSTRACT- Computer vision which is commonly termed as CV is described as the study that helps the computer to recognize and grab the content of digital images like photographs and videos using suitable techniques and recent technologies. In the field of the healthcare sector, the latest technological advancements have been adopted to provide better services to mankind. These are not only saving time of the doctors or Medical practitioners but also saving the lives of the patients. Artificial Intelligence (AI) technology has also been implemented in the healthcare system to help the medical practitioners to recognize and diagnose the patient's problem more precisely and assist the doctor in the simplest way to analyze the patient's condition from which they are suffering from. It also helps the doctors to give the right treatment in the right way depending on the current status of the patients.

Keywords: **Computer Vision, Healthcare Management System, Mobile Communication, Artificial Intelligence, Patient diagnosis, Digital image processing**

I. INTRODUCTION

Computer Vision in the field of medical or healthcare sector is a big advantage because it can be used to dragonize, analyze, predicting the several diseases and it also helps to recognize the content of the images or videos and predict the stage of the disease and assist the medical Practitioner to rectify and helps to give correct treatment. In the another way computer vision with artificial intelligence technology in the healthcare system gives very faster, significant and accurate results than the medical practitioner. This type of diagnosis can be minimizing the false positives and save more time. It can also help the medical practitioner to provide the correct treatment or medicines for the patient. It is not only saving time but also helps to save life at the right time with right treatment.

Computer vision algorithm are trained with a huge amount of dataset which can be detect slightly change or presence of the condition If any changes or missed by the physician or medical practitioner. Therefore, the usability of computer vision in the field of healthcare system can provide high level of perfection. Easy to recognize the even small tiny changes or absences of the condition while diagnosing and it is more accurate than the physician or medical practitioner.

Sometime there can be issue in the hardware or software issue then the data read by the computer vision may be incorrect that can lead to incorrect information is communicated between the machine and the medical practitioner. Then the medical practitioner gives the treatment as per the diagnosis. So to avoid this type of miscommunication between the machine and medical practitioner, regular maintenance of the hardware and software is required.

Advantages and Disadvantages of Computer Vision

There are some advantages and disadvantages of computer vision in the field of healthcare system are as follows:

Advantages

- *Easy and Fast Rectification:*It is easy to recognize the content of the image or videos and faster rectification helps the practitioners to give the correct treatment.
- *Accurate:*Which the physician or medical practitioner has been left to identify that can also be detected through computer vision.
- *Save time and detect the stage of the disease:*It helps the medical practitioners to know from which disease the patient is suffering from through diagnosis report with the help of the computer vision and it also save time of medical practitioner.
- *Right treatment at right time:*It helps the medical practitioner to provide the right treatment at right time through the diagnosis and also with the help computer vision analyses.
- *Save life:*Sometime it helps the medical practitioner to give right treatment to the patient and also can save the life of the patient.

Disadvantages

- *Necessity of Specialist:*It requires the person who is strong in the field of machine learning and artificial intelligence because in the initial they have to teach the machine how to read the content of the image or video and analyze.
- *Software Issue:*Because of the software issue the content read by the computer vision may be incorrect or inaccurate.
- *Regular Maintenance:*The software and hardware components should be maintained regularly so that if there is any issue then there is chance or may be variation while reading the content of the data and that leads to wrong incorrect treatments.

Related Work.

VISION plays a very important role in obtaining knowledge of surrounding. Loss of vision makes the life difficult. In order to overcome the difficulties of visually impaired people lots of electronic aid has been designed based on assistive technology. Traditionally white cane is used by visually impaired people to detect the obstacles. It requires constant activity and conscious to scan the surrounding about the obstacles and give proper information to blind people and who has low vision.

Computer vision through electronic travel aid (ETAs) for blind persons

In (Jinqiang Bai and ShiguoLian, 2015), proposed a system that includes depth camera for obtaining the depth information of the surroundings obstacles, Micro programmed Control Unit (MPCU) for calculating the obstacle distance is used, earphone to get the audio outputs is used. It Presents smart guiding device for visually impaired people which will help them to move safely. Depth image and multi-sensor fusion based algorithms used to solve the problems of small and transparent obstacles. For low vision people, visual enhancement based on AR technique was adopted.

The system mainly focuses on finding right balance between the affordability and efficiency of the ETA's. Size of the stick is small. It overcomes some drawbacks of traditional mobility aiding. This system detects the obstacles efficiently and provides information about the surrounding (Samir patel et. al, 2017). It also makes use of ultrasonic sensors, Bluetooth model and accelerometer. The data is sent from sensor to Smartphone via Bluetooth.

Electronic white stick (Charmi T. Patel et.al., 2018) is designed in order to detect obstacles which is causing problem for visually impaired people using concept of multisensory [3]. Connection of Raspberry pi module with USB webcam and ultrasonic sensor is used to detect object. Earphones connected to audio jack sends alert message. Buzzer sounds when object is found. This is used only for indoor environment.

In order to address the drawbacks of electronic travel aid (ETAs), the design of NavGuide is done which detects wet floors, floor level obstacles and knee level obstacles and it provides prior information. Feedback is given in the form of audio and vibration to the visually impaired people. So that visually impaired people

get alerted and get rid of obstacles and can be safe from falling down or getting hurt. As NavGuide is shoe like one, it will be easy for visually impaired people to make use of it and sensors will be attached to that shoe and detects the obstacles.

Secure Sharing of Personal Health Records in Cloud Environment

The budding patient-centric models for exchanging the personal health information record, often abbreviated as PHR. Its storage is facilitated by a third party like cloud storage providers which often comes with a price of privacy violations. Such important and personal data as PHR's could be at the risk of being exposed to and/or being misused by the third party servers or unauthorized entities on the cloud. Thereby, first encrypting the information and then outsourcing it could be a relieving way to enable the patients to control the accessibility of their PHR which is to be stored on cloud.

Attribute Based Encryption (ABE) techniques that offer a framework to encrypt every patient's PHR file so as to attain data access control which is fine-grained as well as scalable. There have been works on secure data outsourcing previously but what makes from the proposed work is different from them is that it is distinctly considered the scenario of multiple owners of data, categorizing the users of the PHR system into various security domains.

For systems to be usable, they must implement fine grain access control. Traditional systems mostly have both data and applications as a part of the same trusted domain. On the contrary, with evolution of modern systems and with the increasing outsourcing of data on cloud environment, data and users do not share the same domain. The data is itself stored in an untrusted environment where it may be exposed to malicious insiders. This called for attribute based cryptosystems like Cipher Text-Policy Attribute-Base Encryption (CP-ABE). CP-ABE offers an approach to encode a record for numerous clients as per their benefits. On the other hand, this framework fails to offer some of fine grain access control. If a user was added or removed, there was an added overhead of changing the keys associated with the attributes, re-encrypting the records and allocating the new keys.

An extended version of the ciphertext-policy attribute-based encryption scheme (J. Hur and D. K. Noh, 2011) has been proposed, with the addition of two new functions. The first function, KEYGen (U) is used for generating the keys for encryption based on attributes. The second function, ReEncrypt (CT, G) takes as parameter the cipher-text and re-encrypts it for a particular group of users. To go about this scheme, the users are organised as leaves of a binary tree. Each leaf and internal node is then assigned a random key. For every user, the key is denoted by the full path from the leaf up to the root. The system is also flexible, considering the inevitable need to add/remove users. The binary tree is changed only up to the level required. Thereafter, the key of the parent node and hence other users in the group are changed. As a result of this implementation, neither the old user can access the files (since keys have changed) nor can the new user access old files since he will be oblivious of the old key. The system is also proven to be collusion resistant.

Personal Health Records contain very sensitive information that must be protected. In order to be able to access the health records from anywhere and at any time, the PHRs need to be stored on a cloud. But doing so, results in the exposure of the PHRs to unauthorized access and other malicious users. This project allows patients' personal health records to be encrypted before outsourcing on the cloud and they can be decrypted only by users possessing the required keys. The type of encryption used is Attribute Based Encryption (ABE). There are different classes of users that should be able to access the records. Depending on their attributes, they are allowed certain privileges with respect to the PHRs. The owner receives all keys on his registered mail id, and he can share them with the people he wants. Thus his friends and actuaries can view the records using the public key. The patient can also access his records anytime using the secret key. In addition, the patient's doctor can download the patient's records using a master key. There is also an emergency access available, which does not require any key and is helpful in conditions when the patient is unconscious.

This project is standalone software and does not function as part of any other software system. It is a self-contained complete product and is a great improvement over the existing PHR storage options in terms of security.

Design and implementation constraints

The project has various constraints, imposed in the design and implementation, are as listed below:

- The emergency department has free access to the PHRs without the need to enter any key. Thus the login details for the emergency department must be kept confidential at all costs. If the login details are compromised, there is no means by which the authenticity of the personnel can be determined.
- The software is available only in English language.
- The user needs to have internet connectivity to use this application.
- The user needs cloud accessibility to be able to view/store/download the PHRs.
- All users other than the emergency department personnel need to have a registered mail id on which they can receive the key for accessing the PHRs.
- There is no provision to change the language settings of the application's interface, in case someone is more comfortable reading and understanding it in his/her native language.

The different entities interacting with the proposed system as shown in fig 1 are:

- Data Owner (the patient who has to store his PHR on cloud).
- User (patient's relative/friend OR health-care providers like doctors OR emergency department).
- Cloud server (which provides storage facility for the personal health records).

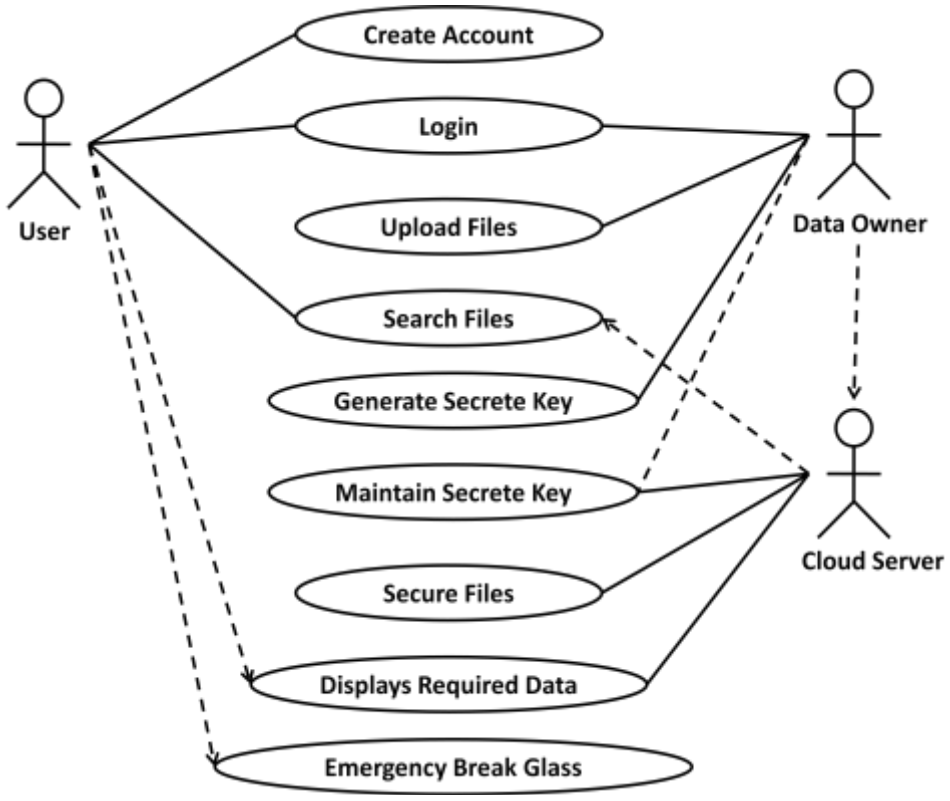

Fig 1. Use Case Diagram of Secure Sharing of Personal Health Records in Cloud Environment

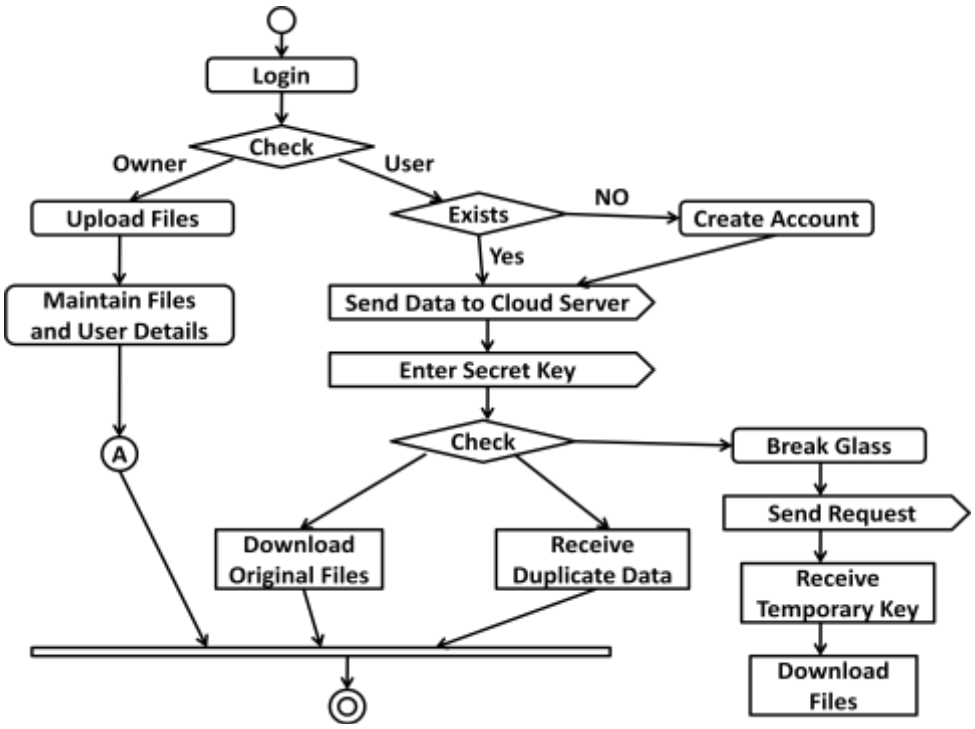

Fig 2. Workflow of Secure Sharing of Personal Health Records in Cloud Environment

Considering the activity diagram of our system shown in Fig 2, here is an overall description of how it works in real time in the actual space where people practically interact or try to interact with the desired data stored on cloud:

- A person tries to login on the login page of the front-end application of this system deployed on cloud.
- The server will check if the person is an owner (patient) or other *user*.
- If he is an owner, he will be directed to the page where he can upload files or/and maintain the details of his uploaded personal health record and also, the details of the users who are allowed to access his medical data in different modes. He can then log out.
- If he is not the owner, i.e. he is a user, then the server will check if he is a registered user or not. If not, he will first have to create an account as new user. Once the person is verified as a registered user, he will be directed to a form wherein he can enter the id or name of the desired file along with the secret key and submit.
- The server will check if the key matches with the correct secret key or not. If yes, the user receives the information about the patient as per the visibility level set by the file's owner for that particular user in "user details".
- In case the logged in user belongs to emergency department, he receives a temporary key using which he gains access to and can also download the required PHR.

Novel approach of computer vision for automated traffic light to aid ambulance vehicle

In today's scenario it can be seen that a lot of developments have been made towards the smart city approach but when we focus on the medical sector, the technological developments are nearly minimal or very poor. The vehicles are poorly equipped with lifesaving technology, undisciplined driver,ambulances available would be struggling in the traffic to reach the hospital on time, etc. Among the total emergency vehicles available, only 8% percent have advanced lifesaving facilities, while the rest are white vans with stretchers. Patients even though they get into an ambulance and reach the hospital on time many patients still die due to improper care and treatments as there are no advance technological developments to trace their previous medical records and provide immediate diagnosis to them.

Emergency response for medical issues in India is still lagging behind, when compared to developed countries. This is due to the lack of technological implementations at ground level. Improvising efficiency in healthcare sector is one of the difficult and most challenging tasks. This includes various aspects such as getting an ambulance and reaching the hospital on time, providing proper first aid to the patients on the way to the hospital and proper treatment to the patients in the hospital so that chances of survival increases. To address these issues, a prototype called A.T.L.A.S. with E.H.R.C. (Automated Traffic Light for Ambulance Service with Extensive Health Report Card) was made.

A.T.L.A.S (Automated Traffic Light for Ambulance Service) is a smart way of managing the traffic such that there will be an automated green corridor for the patient to reach the hospital without waiting much time in the traffic. The major functionality of this will be to detect ambulance from 500m to 1km so that particular lane can be freed on time. To avoid chaos in case of an emergency users are facilitated with a mobile application which helps them to access the nearest ambulance and reach the hospital on time. So, to address this radio frequency module are used which are connected to the Arduino boards for communication between the traffic signal and ambulance.

The second aspect is first aid. The doctors and nurses are bound to do some tests and scanning before starting the treatment. In order to facilitate the early diagnosis and first aid, the project aims in having E.H.R.C (Extensive Health Report Card) which is passive card using Radio Frequency Technology. Even before the patient reaches the hospital, this prototype helps the hospital to trace the medical history of the patient by sending the E.H.R.C data from the ambulance to the hospital through the Wi-Fi module connected to Arduino boards, and hospital management can access data using a user interface, so that the hospital would be ready with all the necessary equipment's for the patient's treatment.

The scope of this is to provide the services of the ambulance globally available by a single tap of the button and help the ambulance reach the hospital on time. The other motto is to serve the people who are not much technically sound so that the ambulance can be booked by single tap of a button and the ambulance arriving at their doorstep to provide at least a mini hospital at nearby place in a high technological manner.

The main objectives of computer vision in Ambulance services are:

- Design and develop an automated ambulance service system.
- To provide an automated green corridor for the ambulance in case of an emergency.
- Prioritizing the ambulance when two ambulances approach the signals based on the criticality of the patients.
- Using a health card to store the patients' medical history and send the desired data from the ambulance to the hospital management system so that prior arrangements can be made without wasting time.
- Sending or notifying the hospital with the location of the ambulance so that prior arrangements can be made.
- Providing a user friendly approach by facilitating the patients or anyone at the site of emergency to book or access the nearest ambulance from the site of emergency.

Related work on existing technologies used in ambulance services

(AgustiZanella, 2014) did a survey on the existing technologies of the ambulance services and discussed that in India a lot of technological improvements have to be carried out in order to facilitate the ambulance to reach on time to the emergency site and provide immediate diagnosis to the patients without and delay in the golden hour. Agusti head of the Smart Health Research Group came up with a solution of facilitating the ambulance to reach the hospital on time. In this work, authors considerable amount of time would be wasted for transferring a message hence this method does not prove to be efficient.

(K. F. Navarro and E. Lawrence, 2010) in one of their papers provided an alternative solution by using wifi technology to provide a green corridor in case of an emergency to the ambulance, but the drawback in this approach is that the use of wifi modules requires a lot of repeaters as the distance of propagation of wifi is

very few meters hence the use of repeaters along the length of the road to notify the signals is not feasible and very difficult to implement.

The concept of using rfid tags for ambulance was another approach which states that the ambulances are provided with rfid tags which are mounted on the ambulance and then use NSK EDK-125-TTL, and PIC16F877A system-on-chip to read the RFID tags attached to the vehicle and the when the ambulance passes the therfid reader notifies the traffic signal to provide a green corridor for the ambulance. But here there would be a problem if there were un registered ambulance approaching the traffic signal and also the criticality of the patients were considered in this approach (Salim, Khalifa&Idrees, Ibrahim, 2013).

Radio frequency transmitter and receiver are used in our model which helps us to provide a green corridor to the ambulance, in (Levi L. Rose, Blasky, 2015), the method helps the radio frequency receiver mounted on the signal to sense the approaching ambulance from a distance of 500 meters and on receiving the packets from the Radio frequency transmitter from the ambulance the signal turns green , in our model we have also added functionalities of handing the criticality of the patients and provide preference to the patients who are more critical using proximity sensors when two ambulances approach the signals and give the priority to the patients who are more critical.

The use of health report cards in the hospitals have benefitted the patients and the hospital management system to keep a track of the patient's treatments and their previous medical history (R. Agrawal, C. Johnson, 2007), but in the proposed model, it has extended this approach by using IOT to send the patients details to the hospital so that prerequisite arrangements can be made to provide the efficient treatment in the golden hour to the patient. Hence in the proposed model we provide an integrated approach to give the immediate treatment to the patients and reach the hospital without any delay (L. Catarinucci *et al, 2015), (*Alessandro Redondi, 2013), (R. Sivakumar, 2016).

Novel model used in ambulance services

The proposed model consists of a new design tocontrol the traffic signals automatically so that the ambulance would be able to cross all the traffic junctions without waiting. Also a smart card that will be used to store all patient's data so that time can be saved and treatment can be given. The process of booking an ambulance can be made easily accessible with the help of a user friendly android application which helps the user to book the nearest ambulance during an emergency. At the sight of an emergency anyone can book the ambulance just by a single tap of the button which summons the nearest ambulance. On receiving the request from the client, the driver gets a notification of booking and will be guided to the site of emergency using maps so that he could reach on time. ATLAS with EHRC provides a spectacular functionality of saving an individual's life by reaching the hospital on time and facilitating the hospital to give the desired diagnosis to the patients without any delay in the golden hour.

For automatically controlling the traffic signals during an emergency we have used the radio frequency transmitters and receivers. Ambulances are equipped with radio frequencytransmitters; the radio frequency receivers are mounted on the signals. In case of an emergency the ambulance starts emitting the radio frequency waves of a certain frequency which will be detected by the receiver from a distance of 500m to 1km, so that a green corridor can be granted for the ambulance to pass through. The signals can be reset using the proximity sensors once the ambulance passes the signals. In case of two ambulances approaching a signal in the same direction or different direction at the same point of time a priority will be allocated based on the criticality of the patients. Hence with this Mechanism we can prevent the delay in reaching the hospital on time in the golden hour.

When the patient is in the ambulance he will have a unique identification card with a unique identification number, this number will be scanned using the rfid reader and sent to the hospital to view his previous medical history so that arrangements can be made to provide immediate diagnosis to the patient.

The ambulance is equipped with a GPS antenna which is used to send the location to the hospital using the ESP8266(internet module) so that hospital can approximately estimate the time at which the ambulance will be arriving based on the distance of the site of emergency.

Architecture of the proposed model.

The architecture is shown in the following fig 3. It contains all the components of the collaborative system.

- Client Application- It is used to summon the ambulance.
- SOS and EHRC Modules: SOS is used by the drivers to update his location for enabling the access to the clients to the nearest ambulance EHRC modules are used to scan and send the data (location and the unique identification number) to the hospitals
- Hospital -Receives the data from the ambulances and makes arrangements for immediate diagnosis.
- Signal -provides a green corridor in case of an emergency

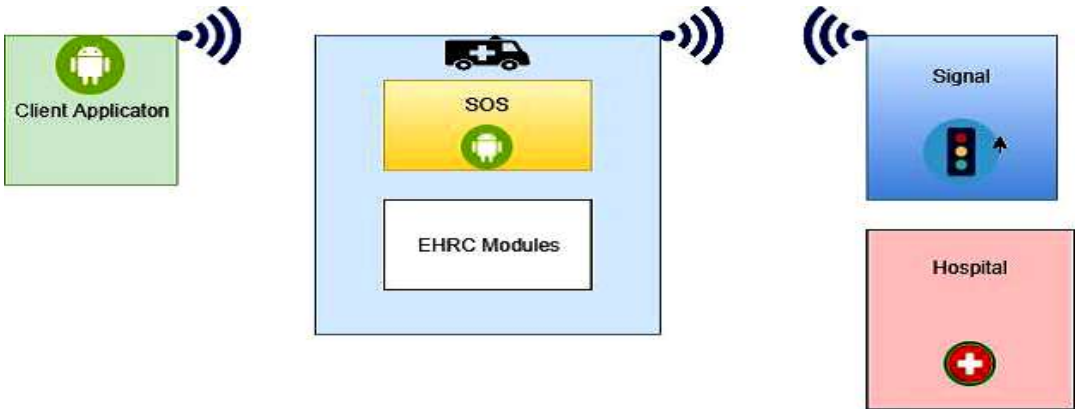

Fig 3. Proposed model architecture

The SOS (save our souls) button in app is used by the drivers to update his location. Ambulances are equipped with radio frequency transmitters. Ambulance also has RFID reader which reads unique ID from the EHRC and GPS antenna retrieves the location and both this data is sent to the ESP8266 wifi module and is sent to hospital via internet and website retrieves all details about patient from database by using his unique ID as shown in fig 3.

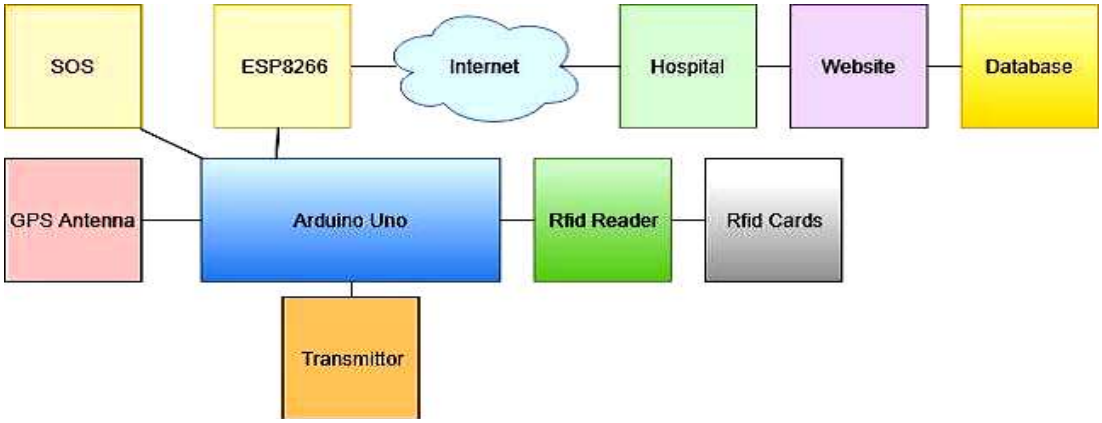

Fig 4. Architecture of ambulance unit

For automatically controlling the traffic signals during an emergency, the model has mounted the signals with radio frequency receivers. Ambulances are equipped with radio frequency transmitters as shown in fig 4. In

case of an emergency the ambulance starts emitting the radio frequency waves of a certain frequency which will be detected by the receiver from a distance of 500m to 1km, so that a green corridor can be granted for the ambulance to pass through. The signals can be reset using the proximity sensors once the ambulance passes the signals as shown in fig 5.

Fig 5. Architecture of traffic light

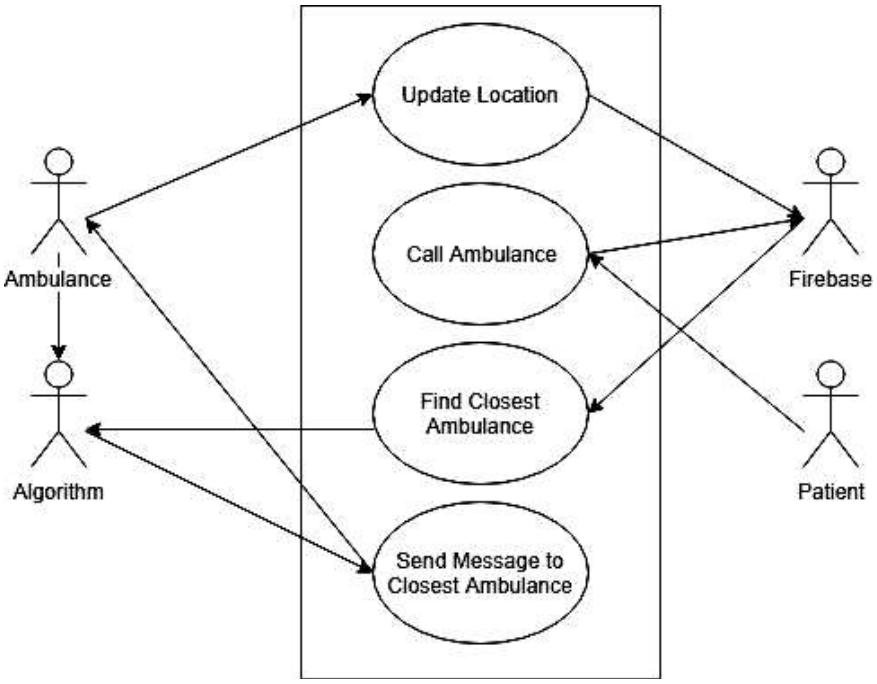

Fig 6. Use case diagram of mobile application for ambulance services

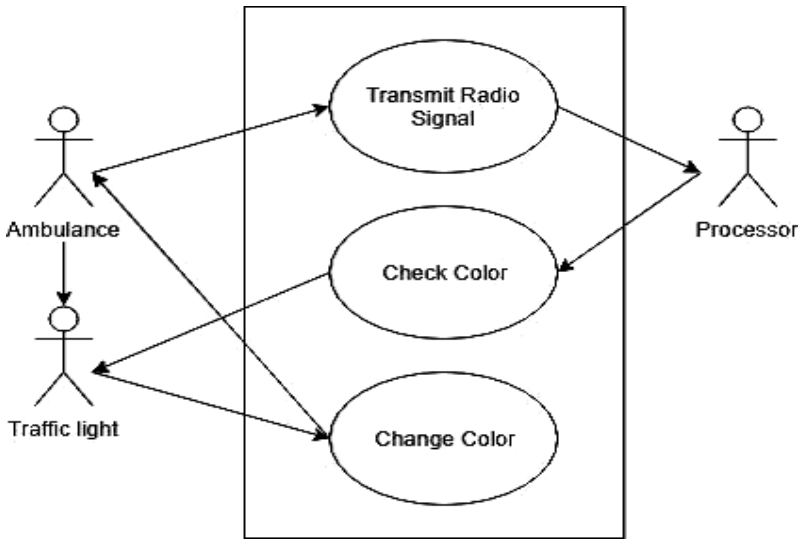

Fig 7. Use case diagram for Automated Traffic Light for Ambulance Service

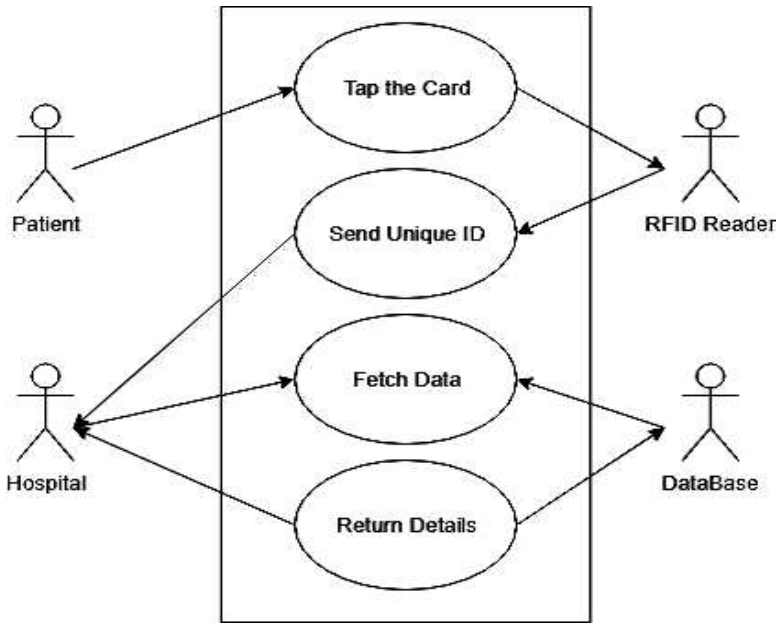

Fig 8. Use case diagram for Extensive Health Report Card.

Fig 6, 7and 8 are various modules used in the proposed model. The components used in these modules are described as follows.

Ambulance Module

The Ambulance module consists of the radio frequency transmitter which transmits the RF waves to the traffic signal in case of an emergency. The ambulance module also consists of an android application which ambulance driver uses to update the location and on receiving a request from the client application he will be guided to reach the site of emergency.

Patient Module

The patient module consists of patient who possess the registered RFID card which can be used in case of an accident or an emergency to get the patients details using unique id stored in the card. The patient module

also consists of an android app through which the patient can summon the nearest ambulance in case of an emergency to reach the hospital on time.

Admin Module
The admin module consists of the admin with the permission to add or delete any new patient's details.

Hospital Module
The hospital module consists of a software which gets the details of the patients during an emergency from the ambulance so that it may facilitate for faster and efficient diagnosis. The Hospital module can get the location of the site of emergency and the distance between the site of an emergency and the hospital so that the hospital can make arrangements based on the approximated time taken by the ambulance to reach the hospital.

Signal Module
The signal module consists of the radio frequency receiver and proximity sensor so that they receive the signals from the ambulance and provides a green corridor for the ambulance and once the ambulance passes the signal the proximity sensor resets the signals.

Test process for the proposed model

Table 1. Sample tests to find the nearest ambulance from application

Scenario description	To find the nearest ambulance from application				
Test ID	Pre-condition	Action and Data	Expected output	Actual output	Result
1	Client should have the "ClientApp" application	Select "summon closet ambulance: button in the application	Should notify the nearest ambulance driver	Notification sent to the nearest ambulance driver.	PASS
2	The ambulance should be the closest one and should be booked	Select "summon closet ambulance: button in the application	State of nearest ambulance should change from 0 to 1 in the firebase.	State changes from 0 to 1	PASS
3	Driver should enroll in the "myambulaneapplication"	Client should select "summon closet ambulance: button in the application	Driver should be notified when client selects "Summon closest ambulance"	Driver gets the message of location of client when client selects the "summon closest ambulance"	PASS
4	Ambulance driver should update the current location.	Click on the "Update location" button in the app.	Location should be updated and displayed.	Location is updated and displayed in the app.	PASS

II. CONCLUSIONS

Although technology and the medical field is advancing, people still tend to loose lives, largely because of ambulances getting stuck in traffic. To address these issues, a prototype A.T.L.A.S. with E.H.R.C was made. A.T.L.A.S can help the society by saving many lives. It can prove to be helpful by providing the Green corridor in case of emergencies. For this, radio frequency modules for communication was used. The Android application finds the nearest ambulance to help the patients to reach the hospital in golden hour. It helps the

driver to reach the destination accurately as the location is sent as a text message. Real time implementation of this Application can make finding ambulances easier without any confusion in the numbers to dial out during an emergency, anyone can help the victim by booking the ambulance in case of any emergency without any formality being required.

After reaching the hospital, time is wasted in carrying out various tests like Blood pressure, sugar, Blood group test etc. In case of emergency all these tests can waste a lot of time. E.H.R.C is the solution proposed for this problem. As this health report card stores all the information which would be helpful in case of the situation mentioned above. In this, passive rfid cards containing entire medical record of the patient have been used which efficiently sends the data over the internet through Wi-Fi module further connected to the arduino board. The main motive was to help society primarily by saving time, and make this entire approach user friendly so that an effective treatment can be given in the golden hour. So this project can be defined as an integrated solution for the emergency situation and can help to save a number of lives.

Future scope for enhancement

The proposed work can be further enhanced by adding the below mentioned features:

- Finding the best fit hospital for the patient according to the disease.
- Integrating all the hospital data in the city along with the medical records of patients.
- Extending first aid facilities in the ambulance.
- Mobile Hospitals booking like the ambulance Application which can get the hospital to the patient rather than taking the patient to the hospital.
- Finding the shortest path to the hospital using efficient algorithms so that the patient can be taken to the nearest hospital.
- Extending the facilities of EHRC where X-rays and other scanned documents can also be uploaded.
- Adding security for the EHRC card so that there is no misuse of the information.
- Integrating EHRC card with biometric data of the person so that one need not even carry their card along with them and can retrieve the information through their finger or iris scan.

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