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FASTER REMEDIAL FOR MEDICAL VICTIMS RESCUE VEHICLE (EMERGENCY AMBULANCE DRONE)

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Abstract- A colossal number of people endures or eventually dies regularly due to the time slack taken by the rescue vehicle to achieve the goal on schedule. This happens because of traffic jams, blockage in streets, inaccessibility of ambulances and so forth. Solution for this is emergency ambulance drone or UAV (Unmanned Aerial Vehicle) controlled by a human sitting in a Hospital control room has been proposed in this paper. This will reach to any of emergency areas as soon as possible along with medical aids which will provide quicker remedies to the victims. The patient's location is sent to the control room via GPS (Global Positioning System) using mobile application and the ambulance drone can be driven to that place with no hindrance. Thereafter it starts video and audio streaming of patient data to the medical center. The medical center can give suitable directions to the spectators or nearby specialists present close to the patient as to how and which equipments (ECG, Pulse rate, Temperature, Oximeter etc) to be used for immediate patient diagnosis. Another method is proposed in this paper if doctors are not present in hospital then, an autonomous system have been design by Decision tree and Machine Learning Algorithm that can determine the probable cause of the Disease by the patient, in an absence of the doctor.
Keyword – ECG Sensor, Pulse rate Sensor, Temperature Sensor, Oximeter Sensor, Raspberry Pi 3, Ambulance Drone

1. INTRODUCTION

The initial couple of minutes after critical medical incidents such as cardiac arrest, brain death, traumas, respiratory malfunctions, blood pressure, diabetes, heart disease or strokes is highly crucial and thus essentially demands prompt and accurate medical aid so that further escalation can be prevented. When medical diagnosis requires relatively long response time (even several hours in rural areas) the lives of the patients are subjected to tremendous risks. Every year, multiple reports on patient deaths are recorded especially pertaining to unfortunate situations such as either late arrival of ambulances or late delivery of critical medical patients to nursing homes/hospitals owing to heavy road traffic instances. Speeding up such emergency responses can drastically reduce human mortality rates and thereby accelerate speedy recovery of patients. Lifesaving technologies such as an Automated External Defibrillator (AED), Cardiopulmonary Resuscitation (CPR) aids, vaccines, prescription drugs, ECG sensor ,Temperature sensor, pulse rate monitor, Oximeter sensor etc. can be designed compactly so that they can be transmitted via drones to the appropriate places of need on demand. In this paper an Unmanned Aerial Vehicles (UAVs) has been designed to employ the air medium, they practically face no hindrances and thus deliver speedy healthcare assistance to prevent deaths from emergency and increasing the chance of his survival from 8 to 80 percent.

Medical ambulance drone can be operated in myriad scenarios. Other than dropping off emergency equipment like a defibrillator to a heart patient or an oxygen mask to a victim trapped in fire or CPR (Cardio Pulmonary Resuscitation) aids to drowned victims, it is also designed to carry a medical toolbox which will further carry insulin for diabetes patients and other medicines like poison antidotes, EpiPen (epinephrine injection). It can even offer medical assistance along hostile borders where manned vehicles (ambulance) might fail to reach timely. Even under situations where patients are remotely located especially in rural areas that lack modern medical infrastructures, proposed medical ambulance drone can be in help for providing telemedicine, drugs, vaccines, prescriptions, or medical supplies to combat critical medical situations. So it effectively serves as all in one solution when helping trapped victims or providing first-aid is concerned.

In this paper the different sensors that used in proposed ambulance drone are a ECG , Temperature , pulse rate monitor, Oximeter sensor etc. ECG sensor is utilized to measure the heartbeat's electrical periodicity and moreover the presence of any mutilation to the heart [1]. The temperature sensor is an easy way for distinguishing the patient body temperature [2]. Pulse rate sensor calculates the real-time pulse rate and calculates BPM [3] whereas Oximeter sensor is used to measure a patient's blood-oxygen saturation level. [4]. ZIGBEE or a SIM card module is essentially utilized for the transmission of information accumulated from the crisis area.

The Paper is organized in the following manner. Section II comprises of a survey on the existent work on emergency medical drone. Section III depicts a proposed hardware used in the proposed technique. Section IV discusses about the proposed architecture. Section V concludes the paper.

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2. LITERATURE SURVEY

As the time evolves different researchers all through the world have worked in the area of Medical emergency drone and execution of their proposed methodologies. In this section, a detailed review of the existing work has been displayed.

Researchers A. S. Kristensen et al. [5] brought forth an innovative countermeasure for traffic accidents, which are increasing day by day due to human's negligence, irresponsible behavior, incaution attitude and so on that have drastic effect on economic and health. To get rid of it is next to impossible, but with quick response to rescue and first aid treatment, the mortality rate of foisted persons can be reduced. Smart and imaginative advancement can play a vital role to react quicker to car accident crises when contrasted with ambulance. For example, Rescue Emergency Drone (RED) can give quicker and constant solution. The effects of the examination exhibit the heartiness of RED into crisis administrations to help spare lives.

Researcher S. J Kim et al. [6] focuses on drone-aided delivery services to inflicted persons and test kits for patients with chronic diseases especially in rural areas. For routine healthcare benefits, the work proposes two models: the principal focus is to locate the ideal number of automaton vehicle using the set covering approach, and the second model describes multi-stop vehicle routing using pickup and delivery request for minimizing the expense of UAV in which it deliver medicines and medical kits. A Lagrangian Relaxation and Partition method are used for improving performance of proposed models.

Researchers J. E. Scott et al. [7] reviews the present status of drone conveyance with a specific emphasis on medicinal services. The main organizations in this field and their diverse techniques are examined. Further reviews have been made on the most recent decision models that encourage the decision for UAV fleet. The paper comprises of two new models that will facilitate timely, efficient and economical medical services.

Researcher J. Lennartsson et al. [8] works on the quantity of out of hospital cardiac arrest (OHCAs) that happens in Sweden. There is ongoing examination to perceive what should be done to improve the survival rate. Openly available defibrillators are one thing that is being actualized as the likelihood of conveying it by drone, particularly to places that are difficult to be reached by an ambulance. The investigation was done with Multi Criteria Evaluation, is a power spatial investigation instrument that considers numerous criteria in decision-making environments. With it suitable places can be identified by adding different data and weighing them according to their importance. From the result it is shown that best place for ambulance drone is city center where most OHCAs occur.

Researcher A. J. A. Dhivya et al. [9] proposed a rescue vehicle for the severe medical cases. The emergency area is tracked by GPS location tacking system. The ambulance drone enters the scene in the moment time and ongoing directions are given by the administrator. The automaton comprises of variant sensors which can be joined to the patient's body and the imperative parameters are being estimated and quickly sent to the nearby hospitals using GPS and ZIGBEE. The result helps the doctors to analyze the circumstance faster with better diagnostic and restorative decisions. In this way, the objective is to create a therapeutic toolbox that can be flawn to any medical emergency situation and is utilized in giving the actual time circumstance results to the ambulance and hospital with an aim that they will be prepared to serve to the necessities of the patients.

The next Section describes about different types of hardware as well as sensors used in the paper.

3. PROPOSED HARDWARE

In this paper an emergency Medical drone controlled by a human in a Hospital control room has been proposed. During any emergency situation such as when an accident takes place or someone gets a cardiac arrest, an immediate medical treatment is needed, someone nearby can make use of the emergency call using mobile app and call for the drone. The patient's location is sent to the control room via GPS (Global Positioning System) and the ambulance drone can be driven to that place with no hindrance. Thereafter it carries a ECG Sensor, pulse monitor, temperature sensor, Oximeter sensor, medicines etc. Live streaming of the whole process takes place through raspberry camera module attached on the drone, thus making it easier for the person controlling the drone to judge the current situation of the patient with the assistance of a specialist doctor and give prompt care like medicines, gauges, cotton, drugs, prescriptions etc. prior to an ambulance arriving from the nearest hospital. All the data for the above process are transferred using GSM protocols and ZIGBEE. The proposed hardware and the working model is described below in fig.1.

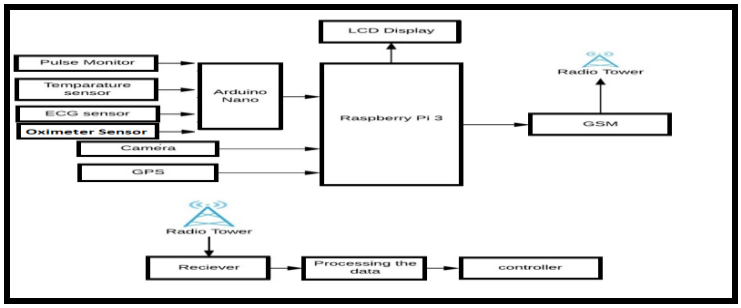

Fig. 1 Proposed System

However, it for the most part contains Pulse sensor, ECG sensor, Arduino Nano, Temperature sensor, Oximeter sensor Raspberry Pi 3, Raspberry Camera module, GPS, and Quadcopter. Every single part of the framework is clarified underneath.

3.1 Raspberry Pi 3

Fig 2Raspberry Pi 3

It is a credit-card sized smallest fully featured computer on board, which runs the Linux operating system shown in Fig. 2. It has a 1.2GHZ processor with 1GB RAM, Wi-Fi and Bluetooth built in. It has one Ethernet port, four USB ports and two columns forty General Purpose Input Output (GPIO) pins on one side of it. These pins are called GPIO connector .This allows attachment of electronic hardware to the Raspberry Pi. In order to connect all the necessary sensors and other microcontrollers for obtaining data which is required in the process, GPIO pins are used. It is an alternative option for a USB port.

3.2 Arduino Nano

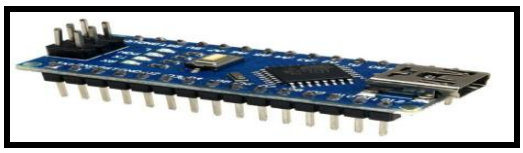

Fig. 3Arduino Nano

The Arduino Nano (Fig.3) is a small, complete, an open source computing platform that is utilized for building and programming electronic gadgets. It uses Atmel Atmega328p microcontroller and code has to be written in Arduino IDE (Integrated Development Environment) and thereafter be uploaded in the board and then it can be used. The Arduino IDE additionally gives a simplified integrated platform which can keep running on PCs and enables clients to compose programs for Arduino utilizing C or C++. The ECG, Pulse rate monitor, temperature and Oximeter Sensor are controlled by it and then data is sent to Raspberry Pi. C.

3.3 Pulse Rate Sensor

It is an Open Source pulse sensor [3] monitor which is considered as a PPG device used to monitor the non-invasive pulse rate. It calculates the real-time pulse rate and calculates BPM with the help of program implemented by Arduino. This sensor shown in Fig. 4 has two sides, the front one which has a heart shape is the side to be attached to the skin on which if someone's finger is kept for few seconds it can detect that person's pulse rate. The sensor output is in electrical signal form and is proportional to the person's pulse rate. The Pulse sensor converts the physical PPG into electrical signals. The sensor outputs a raw signal of analog voltage fluctuations amplifies it and normalizes the wave at V/2. With each beat of the heart, a heartbeat wave makes a trip along all supply routes to the tissues where the beat Sensor is appended.

Fig. 4 Pulse Rate Sensor

At the point when this heartbeat wave goes under the sensor, the signal encounters a fast upward ascent in its esteem. It falls down toward the typical point and before the next heartbeat sensor goes under the sensor, the signal stabilizes to the ambient noise. Due to the repetitive characteristic of the pulse wave, the peak is chosen as a reference point because it's recognizable. By applying calculation algorithm on the time between each two successive peaks the pulse rate is measured. The aim is to find out instantaneous moment of the pulse rate for accurate measurements. This is implemented by interfacing the pulse sensor with the Arduino board and the equivalent Circuit design as shown in Figure below (Fig.5 and Fig.6).

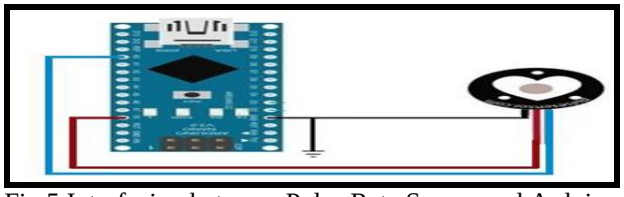

Fig 5 Interfacing between Pulse Rate Sensor and Arduino

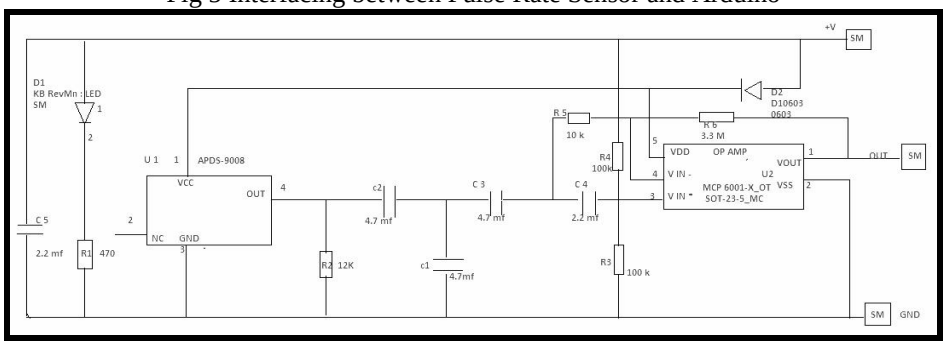

Fig 6 Circuit Design

3.4 ECG Sensor (AD8232)

ECG stands for Electrocardiogram which is used to calculate the heart's electrical activity. The ECG signals are noisy thus here AD8232 sensor [1] shown in Fig. 7 is utilized to get the heart activity in a smooth waveform. Here three electrodes are utilized to acquire the signals. The red one is connected in right arm, yellow one in left arm and green one in left leg. The AD8232 is an integrated sensor for signal conditioning of cardiovascular heart rate observing. Furthermore, there is a LED indicator light that will give rhythm of a heartbeat. This design diminishes size and power compared with different chips. AD8232 is preferred over other chips because it has the best output impedance and gain. The schematic diagram of AD8232 is given in Fig.8 below.

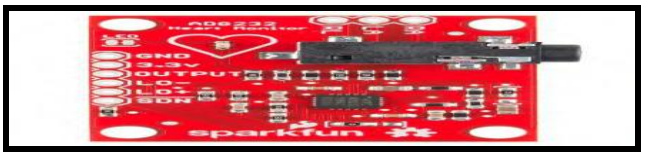

Fig. 7 ECG Sensor (AD 8232)

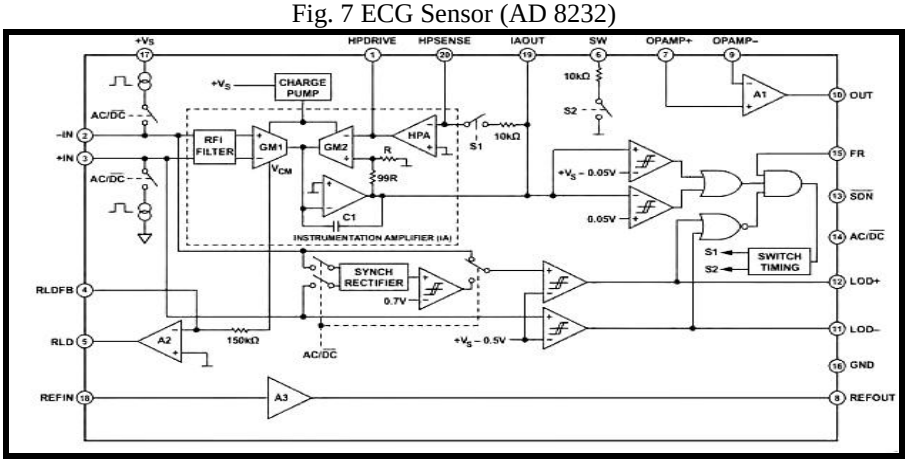

Fig. 8 Simplified schematic diagram of AD8232

3.5 Temperature Sensor (LM35)

It is considered as a solid state sensor. Temperature sensor [2] output a voltage directly corresponding to the centigrade temperature. As the pulse sensor, LM35 three has three pins except that the leftmost pin is for the input voltage, while the middle one output the signal shown in Fig. 9. Therefore, the pin on the right is the GND. With LM35, temperature is measured more precisely than using a thermistor. For accurate readings, the sensor's package required to be in contact directly with the patient arm tissues. This is cover with plastic package and Arduino is used for measured temperature. The interface between the LM35 and Arduino is explained in the following Fig. 10.

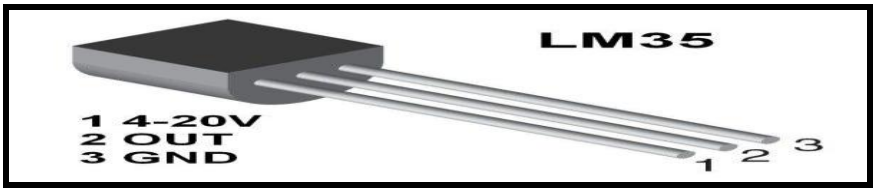

Fig. 9 Temperature Sensor (LM35)

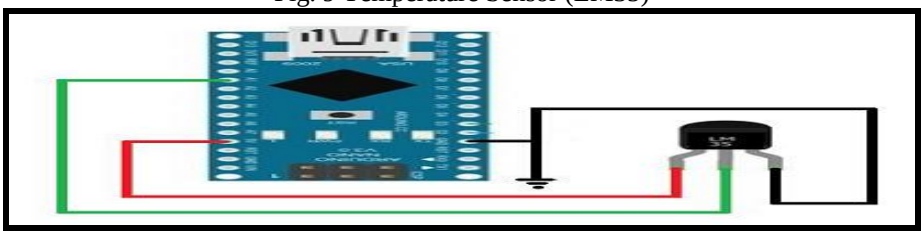

Fig. 10 Interface between LM35 and Arduino

3.6 Oximeter Sensor (MAX 30105)

The MAX30105 is a high-sensitivity oximeter sensor [4]. It uses LEDs, photo detectors, optical components, and low-commotion gadgets with encompassing light dismissal. This sensor is small enough to be used with wearables and mobile devices. The operating voltage is 1.8V and a separate 5.0V for the internal LEDs. MAX30105 uses standard I2C compatible interface to communicate with the Arduino. The sensor compares the reflected infrared and red light deciding the SpO2 reading. Fig.11 and 12 shows the MAX30105 sensor and Circuit design.

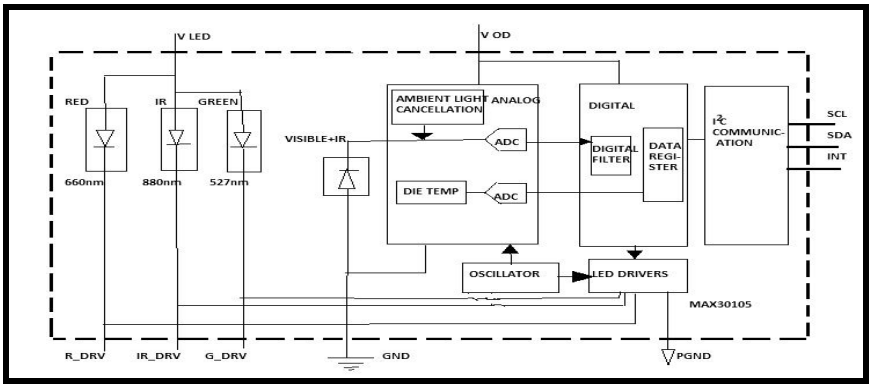

Fig. 11 Oximeter Sensor (MAX 30105) Circuit Diagram

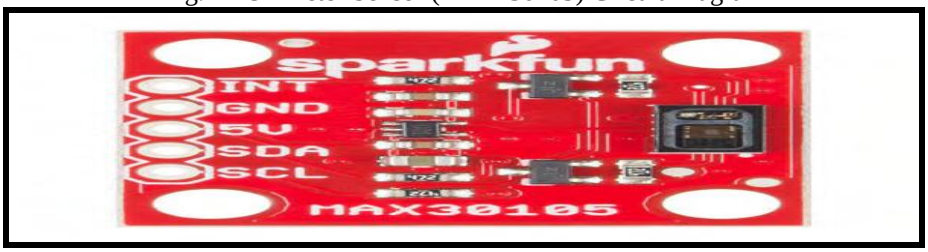

Fig. 12 Oximeter Sensor (MAX 30105)

3.7 GPS sensor

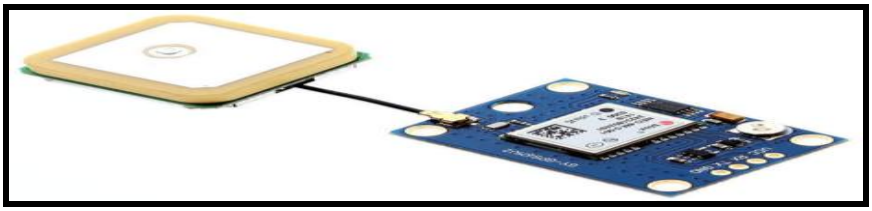

Fig. 13 Ublox Neo – 6M GPS Sensor

Ublox Neo-6M GPS sensor (Fig.13) used to recognize the Latitude and Longitude of any area on the Earth, with exact UTC time (Universal Time Coordinated) thus locating the drone once it is sent from the control room. Ublox has created a proprietary output format that displays the position data in integer format rather than text. The GPS has several

communication standards available including SPI, I2C, and UART. In this paper the Universal Asynchronous Receiver/Transmitter (UART) communication ports were utilized. This device receives the coordinates obtained by a python code in raspberry pi from the satellite and is sent to the control room in a secured manner through ZIGBEE/GSM protocols for each and every second. Thus GPS offers great accuracy and also provides other data besides position coordinates.

3.8 Raspberry Pi Camera Module

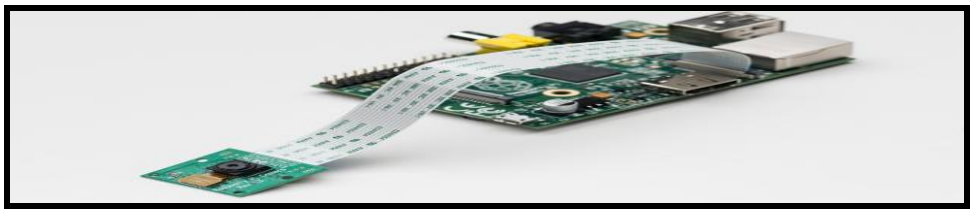

Fig. 14 Raspberry PiCam NOIR 8MP

In this paper Raspberry Pi's Cam NOIR 8MP low light camera is used. It is capable of taking images and videos quiet fast and it stores them in the Pi's secondary storage device. It has 8 megapixel camera equipped for taking photos of 3280 x 2464 pixels and captures video at 1080p30, 720p60 and 640x480p90 resolutions. Attached with a 15cm ribbon cable to the CSI port on the Raspberry Pi. Also consists of DSI display port for interfacing a Raspberry Pi touchscreen and Micro SD port for storing OS and storing information. Accessed through the MMAL and V4L APIs, and there are various third-party libraries worked in for it, including the Pi camera Python library.

3.9 Quad copter

The quadcopter [10] is assembled with the help of F450 frame, four Brushless Direct Current motors (BLDC), four Electronic Speed Controllers (ESC), Lithium polymer battery of 2200mah, Propellers and a simulator. Most thrust can be made with enhancement in the number of motors and propellers. So, usage of the quad copter as the structure includes 4 brushless direct current engines (BLDC) which are used for giving fundamental push to the propellers [11]. A 2200 milli-ampere hour (mAh) electrical storage device controls the automaton. The automaton all around furnished with a patient watching framework is expected to travel to an accident or crisis zone and it is used to control the circumstance there [12].

Fig. 15 Quadcopter

Following Section is about proposed architecture. Basically two scenarios have been taken into consideration one in presence of doctors and other in an absence of doctor.

4. PROPOSED ARCHITECTURE

The sequence of events and actions that are followed in our design is briefly stated below:

4.1 First Architecture

In this proposed architecture shown in Fig. 16 with the help of mobile app, the patient party can submit the patient details (ailment, phone #). On receipt of information, the hospital authorities will track the patient location using the GPS feature within mobile app and trigger the Medical Drone (Dr. Skyhawk) to fly to the desired location. Once the Medical Drone (Dr. Skyhawk) reaches the desired location, it starts video and audio streaming of patient data to the medical center. Through the Medical Drone (video-sound enable mode), the medical center can give suitable directions to the spectators or nearby specialists present close to the patient as to how and which equipment is to be used for immediate patient diagnosis. Following the instructions, immediate temporary medication can be furnished to the patient. Additionally, the Medical Drone can record a snap of the patient face using face detection algorithm (HAAR-Cascade classifier). In the medical center, the face is recognized using LBP histogram, if a match occurs, then the prior patient history can be reviewed to offer better treatment to the patient.

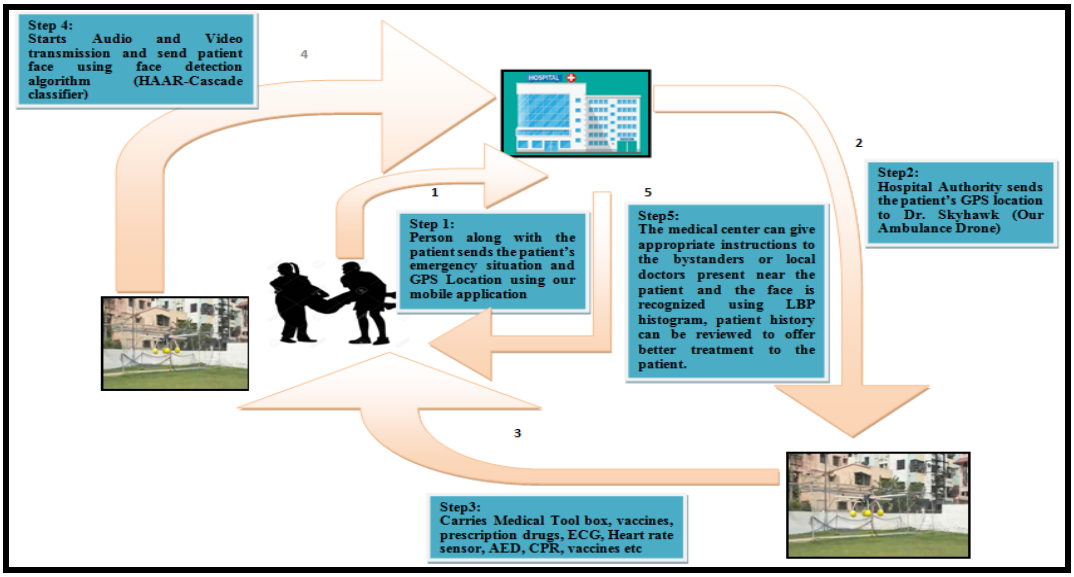

Fig. 16 First Architechture

4.2 Second Architecture (Where Doctors absent, but Administrative Staff Present)

If doctors are not present in hospital then, in this paper with the help of Decision Tree and Machine Learning Algorithm an autonomous system have been designs that can determine the probable cause of the Diseases by the patient, where administrative staffs are there as shown in Fig.17.

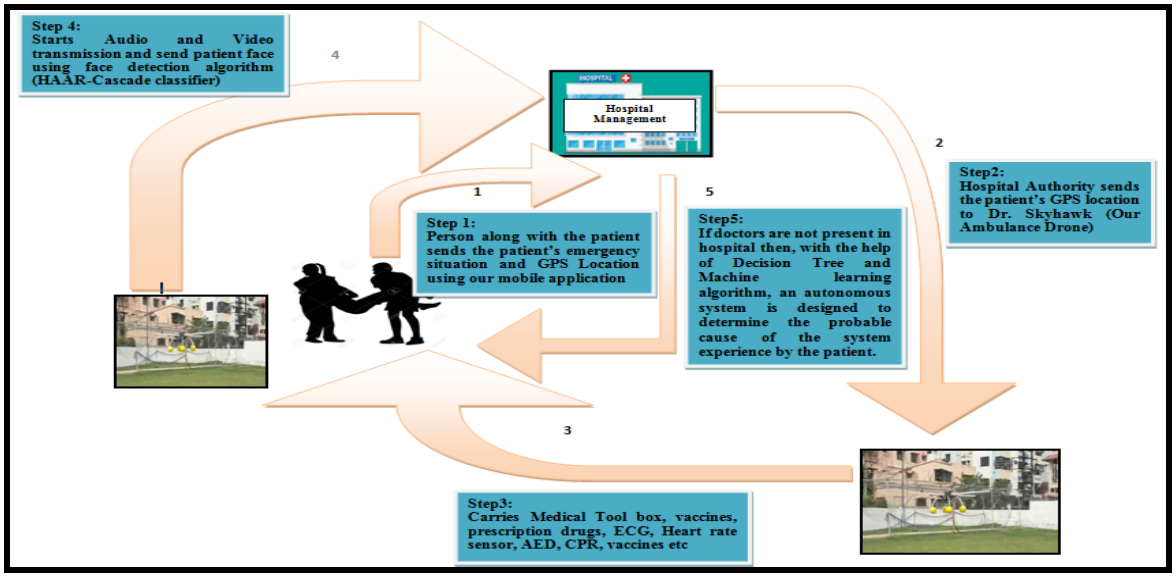

Fig. 17 Second Architechture

Next Section give conclusion of the paper.

5. CONCLUSION

The number of victims due to inaccessible of ambulances on time are increasing day by day, hence the death rate are exponentially rising. Minimization of this is completely impossible. Thus a remedial solution for the same is the Ambulance drone which will reach the destination on the time along with medical kits which includes drugs, prescriptions, medical sensors etc and hence the survival rate of patient's may increase. The drone will carry different types of sensors such as ECG, pulse rate, temperature, Oximeter sensor etc have been studied in detailed in this paper. The focus of the paper is mainly on two scenarios one in the presence of doctors and latter in an absence of .The live streaming of whole situation will be studied by the medical center and hence will render services to the patient which will help them in faster recovery. In next case, an autonomous system have been design by considering decision tree and Machine Learning Algorithm that can determine the probable cause of the Disease by the patient in an absence of doctors.

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