An Automated Chronic Disease Management for Cardiac Arrest Detection and Prevention on Emergency usingInternet of Medical Things (IoMT)

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Abstract— The Internet of Medical Things (IoMT) is a world of interconnected things that can sense, stimulate, and collaborate with one another and with the environment. Heart attacks have become more common in recent years, putting people's lives at risk. However, it is extremely complex and difficult to maintain/monitor health conditions in physical mode all the time, especially at night and while traveling. If a senior person or patient suffers from health issues such as sudden cardiac arrest or a rise/fall in blood pressure levels in their body, it will be incredibly tough to receive immediate assistance from others as well as medical agencies. The suggested method uses a pulse sensor to automatically monitor heart rate and a MEMS pressure sensor incorporated into IoMT devices to measure blood pressure (BP). If an elderly individual has a cardiac arrest, an automatic call with the exact GPS location is sent to a nearby ambulance service and their caretakers. The benefit of this method is to prevent unexpected death or major illness due to heart disease and may also be conveniently monitored by sending text messages with their heartbeat rate as a daily report to caretakers.

Index Terms—Blood Pressure; Cardiac Arrest; Heart Attack; Health Care; IoMT.--*

I. INTRODUCTION

Sudden cardiac arrest is the greatest cause of death in high-income countries [1]. Although outcomes vary depending on location and facility, most individuals admitted to the hospital after recovering spontaneous circulation do not survive to discharge [2-5]. Because of the wide range of outcomes and the complexities of treating sudden cardiac arrest, the National Academy of Medicine [6] and the American Heart Association [7] recommend the establishment of regional systems of care. Although hospital-level variables such as caseloador advanced procedural capabilities are infrequent predictors of in-hospital mortality, other studies suggest that care at specialised centres that provide a full bundle of

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SCA therapy may be beneficial in the long run [4,8,12]. Similarly, enabling EMS to bypass local hospitals in favour of sending patients directly to specialists has been linked to improved outcomes in several countries [15,16].

To provide sufficient triage and access to specialised care, several measures have been implemented. Depending on caseload and resource availability, trauma systems establish multiple hospital levels, and EMS or initial receiving hospitals direct patients to these institutions based on the severity of their injuries [17,18]. Acute stroke is currently treated in a similar manner, with many primary stroke clinics offering instant access to time-sensitive early medications before referring specific patients to comprehensive stroke centres for sophisticated ongoing specialty care [19]. After restarting spontaneous circulation, patients who have suffered a sudden cardiac arrest are frequently sent to the nearest facility. Except for reports from a single clinic, it is unclear how patients who have experienced a sudden cardiac arrest would fare after being transferred to a facility that will provide them with ongoing acute and post-acute care.

The proposed approach is to create an IoT system that automatically finds and saves humans because we (humans) are incapable of responding appropriately in the dire circumstances described in this study. IoMT devices have a MEMS pressure sensor and a pulse sensor to detect blood pressure in the case of a medical emergency. A GPS module is part of a device that can be used to locate a person experiencing cardiac arrest by learning their latitude and longitude. Following the feeding of this position to the microcontroller and a GSM module to call and SMS the alarm message to the user's carers and a local ambulance, a "Patient Suffered from Heart Arrest" text, and a live location contained in the SMS module.

II. LITERATURE SURVEY

The authors of [20] investigated sudden cardiac arrest, the main cause of mortality in high-income countries. Due to complexity and outcome unpredictability, using many approaches may not always result in providing optimal care. According to the severity of the injury, EMS or the initial receiving hospital may directly transport patients to specialized facilities. Depending on how many cases of sudden cardiac arrest were handled over a four-year period, hospitals were classified as low, moderate, or high volume. Hospitals with low volume treated less than 100 patients, those with moderate volume handled 100–399 cases, and those with high volume handled at least 400 cases.If the smartphone it regularly communicates with is off and there is no other immediate warning, this device will not be very useful.

The notion of connected health care systems and well-designed embedded IoT devices were used by the author to construct a device in [21], which provides potential for profit for all businesses and people. The gadget is made up of an Arduino UnmTM, a low power Bluetooth chip, temperature and pulse sensors, a power supply unit, and a smartphone. The aim is to establish a system that will help patients better understand their health state and deliver early medical warnings by using research on new technologies to influence the creation, enhancement, and extension of connected health systems.GSM module is not supported by the entire system;thus, it is impossible to know where the patient is and to prepare for an emergency treatment.

In [22], the author created an IoT technology that can aid in increasing their power, property, economic growth, and voter quality of life. In this study, a Python simulator is being created and an Ubuntu server is being run on Amazon's Elastic Compute Cloud (EC2) through Amazon Web Service (AWS). In order to determine the optimal number of drones for reducing response times, the simulator uses a range of datasets that describe the geolocation of publicly accessible AEDs.The adoption of associated emergency services

autonomous drone networks may be slowed by these regulations. A drone network may also be challenging to build successfully in the event of unforeseen weather.
In [23], a device that uses ECG, temperature, and sweat sensors to monitor heart conditions and body temperature. The data is transmitted via Bluetooth to a software system installed on the patient's device and the hospital's system. A display module presents the data to the user and hospital. The device detects changes in heart ratewhena person stands up suddenly.Typically, a band's connection is one-way, meaning the band can only send data and cannot receive it. The automation of the ambulance's work process encounters a snag.
In [24], the authors created a brand-new IoT system for monitoring patients utilising sensors and wireless transmission. The device uses an Arduino microcontroller and KY-039 fingertip sensor as a cardiac arrest warning system. The ESP8266's WI-FI module gathers data, which is then transmitted to the cloud via a phone app. An alerting system that sends SMS messages makes use of GSM. Caregiving and patient monitoring are now easier thanks to IoT.To advance the patient's current medical condition, this device used an Arduino microcontroller. The ESP8226's Arduino implementation is not any more exact.
In [25], the author created a wearable device that uses a wireless body sensor network to avoid sudden cardiac arrest. (WBSN). The Modified Huffman technique is used to compress the sensor data before it is sent to the cloud via a gateway. PDH-AES is used to encrypt the data in order to protect privacy. To help with diagnosis and therapy, a patient monitoring system based on IoT-focused Deep Learning changed Neural Networks (DLMNN) is proposed.Using a deep learning system, they identify the problem and spread out the knowledge over a smaller area.
In [26], the author created an IoT device that uses a modified Deep Convolutional Neural Network to increase the accuracy of cardiopathy detection. (MDCNN). An Omron HeartGuid-bp8000m sensor, an AD8232 device to verify electrocardiographic data, a wristband and monitor that measure and graph blood pressure levels, and more are all included in the gadget. Data is sent over Long Range (LoRA) to a cloud server where it is processed using a Raspberry Pi single board. The MDCNN distinguishes between traditional and atypical sensing element knowledge. The device classifies outcomes as normal or abnormal after being trained on data from the Framingham dataset. The study did discover that the identification findings had poor precision, though.
The author created an internet of things for the healthcare system [27]. by cultivating them in distant areas, which seeks to prevent chronic heart disorders (CHD). A novel local multisensory fusion triage approach has been proposed, called the three-level localization triage (3LLT) algorithm. A blood pressure, SpO2, and ECG monitor are included in the sensor for mHealth vital sign communication. Two levels of 3LLT offer a mathematical representation. By using a variety of heterogeneous sources to triage patients as a clinical process, 3LLT establishes the emergency levels within and outside the patient's home who has CHD. Additionally, problems in sensor fusion can be discovered.It can only handle the information included in training data. After problem identification has been performed in this manner, it is therefore not possible to transfer the alert to Medicare.
Using an IoT-enabled ECG telemetry system that records and analyses ECG signals and alerts clinicians to emergencies, the authors of [28] built an IoT platform to anticipate cardiovascular sickness.They sent signals to the processing system using an Arduino controller and an AD8232 ECG sensor. The Pan Tompkins technique and QRS detection with bandpass filters are used by the system to find peaks. The RR interval indicates heart rate variability after processing with wavelet and Hilbert transforms. The platform makes it possible to diagnose heart issues quickly and precisely. Since the GPRS module is not supported by the entire system, it is challenging to calculate the patient's latitude and longitude in order to plan for emergency treatment.
In [29], the author created a 32-bit microcontroller architecture-based IoT platform for classifying ECG signals. When an irregularity is found, the system generates a warning

message and can classify 16 different types of ECG patterns. Additionally, the technology sends data to a remote platform so that hospitals can take preventative action. An ADC, an external display unit, and a Wi-Fi low-power module are all included in the system. The system can monitor heart illnesses utilizing a network of wireless sensor nodes, and the prediction accuracy was determined using K-fold cross-validation. The platform offers a structure for healthcare to efficiently monitor cardiac disorders.The ECG signal is evaluated, and abnormal conditions are informed to the doctor; however, because there is no GPS, the patient's location is not communicated with the medics.

III. PROPOSED SYSTEM

The proposed system uses wearable devices equipped with GPRS and pulse sensors to detect the user's location and vital signs, respectively. The system employs a microcontroller that processes the data captured by the sensors and sends an SMS message to a nearby ambulance and the user's preferred contact in case of an emergency. The message includes a live location and a predefined text indicating that the patient is suffering from cardiac arrest.

A. Working Flow

The system begins by sensing the user's state, likely using sensors such as accelerometers or heart rate monitors. The device has an internal heartbeat or pulse tracker that continuously monitors the user's pulse rate. A prediction algorithm uses the data from the pulse tracker to forecast the pulse rate and identify any anomalies in the data. These anomalies could include sudden drops or spikes in the pulse rate that may indicate a medical emergency.

If the algorithm detects an anomaly in the pulse rate data, the system initiates a response. The GPS/GSM module in the device records the user's location and sends a call and SMS with the location to the nearest ambulance as well as to the user's emergency contacts. This enables emergency responders to quickly locate and aid the user.

Overall, this system is designed to provide a rapid and effective response to medical emergencies by continuously monitoring the user's health and automatically initiating emergency services when necessary shown in Fig 1

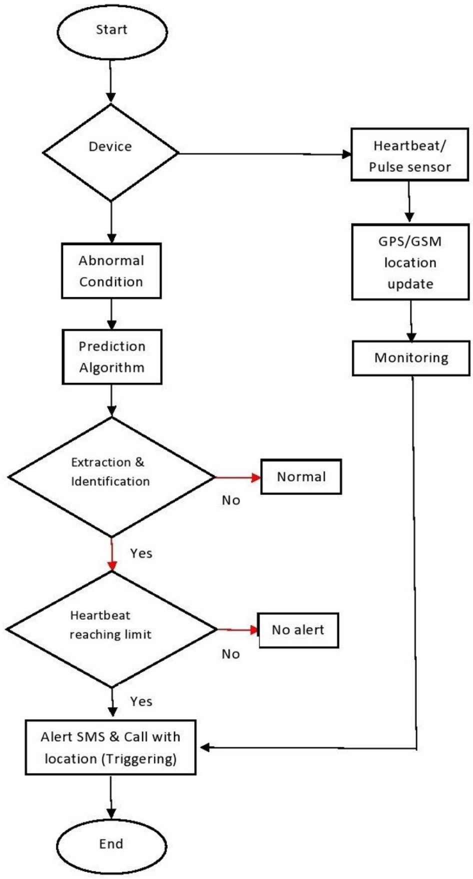

Fig.1. Workflow of IMoT device

B. Methodology

The proposed system consists of a wearable device equipped with a GPRS module and a pulse sensor, a microcontroller, and a GSM module shown in fig 2

To activate the device, the GPRS module captures the wearer's location using latitude and longitude data, which is then sent to the microcontroller. The pulse sensor, which is installed in healthcare equipment, is used to detect the wearer's blood pressure and heart rate.

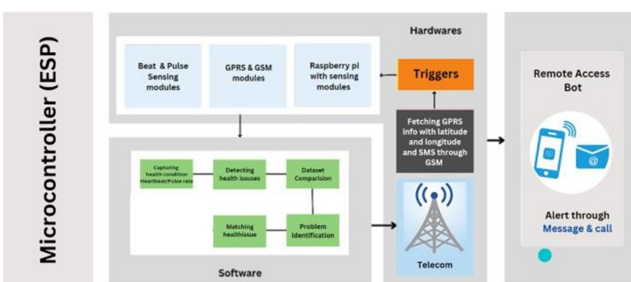

Fig. 2. System Architecture

The microcontroller analyses the data from the pulse sensor using the logistic regression method, which has an accuracy of 88.9%. Based on the analysis results, the microcontroller instructs the GSM module to process calls and send an SMS message to a nearby ambulance and the user's choice. The SMS message includes information about the

emergency, such as "Patient Suffering from Cardiac Arrest," and the wearer's live location, which can help emergency responders quickly locate and aid the wearer.
Overall, the procedure described above provides an effective and efficient way to detect and respond to emergencies, particularly for those who are at risk of heart-related health issues. By using wearable technology, emergency services can be alerted promptly, and the wearer can receive timely medical attention, potentially saving lives.

C. Healthcare Device Working

The healthcare device is equipped with an ESP8266 microcontroller and a NEO 6m GPS module to detect sudden cardiac arrest. When such an event occurs, the microcontroller starts collecting real-time position updates from the GPS module shown in Fig 3.. This means that the device can track the location of the person experiencing sudden cardiac arrest. After collecting the latitude and longitude information, the microcontroller then communicates it to the appropriate parties via SMS and a call to a local ambulance. This means that emergency services can be quickly alerted to the location of the person in need of medical attention.

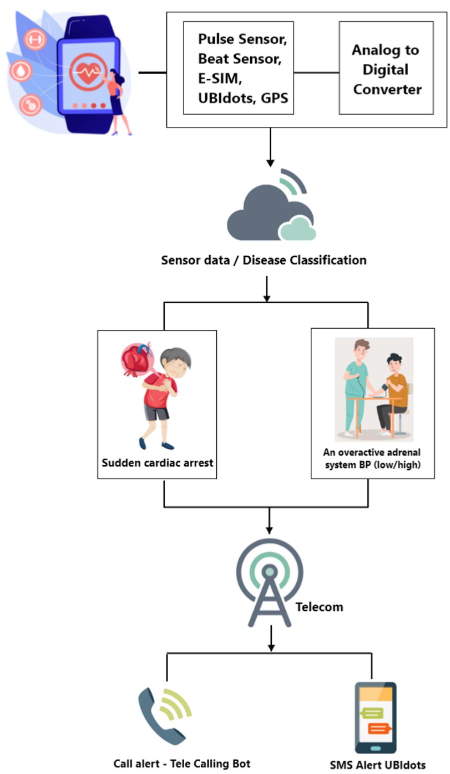

Fig. 3.Healthcare Device Working

D. Live Location Identification

Once the GPS module has calculated the user's latitude and longitude coordinates, it can send this information to a microcontroller or another processing device that can use this information in various applications. In the above scenario, the GPS module is connected to a microcontroller that collects the latitude and longitude data and sends it to the family and the nearby ambulance station.
To send this data, a Google Maps link is created that contains the latitude and longitude information. This link can be sent via SMS or any other messaging platform to the family and ambulance station, allowing them to view the user's location on a map. By using GPS

technology, this system provides an effective solution for tracking the user's location and providing real-time updates to their family and emergency services.

gps.read() – to extract raw GPS data from the NEO-6M GPS module attached in the microcontroller

gps.readline() – It is used to organize raw data and feed it into the NEO 6M GPS module.

gps.split() - the data fields of the received NMEA message to an array using the comma as a delimiter

E. Communication

An IoT trigger or event is used to send an SMS and an automated call. Real-time data monitoring is feasible with an internet connection, so the GSM module can send alarm messages and calls anytime a sensor reaches a predefined programming threshold value shown in fig 4

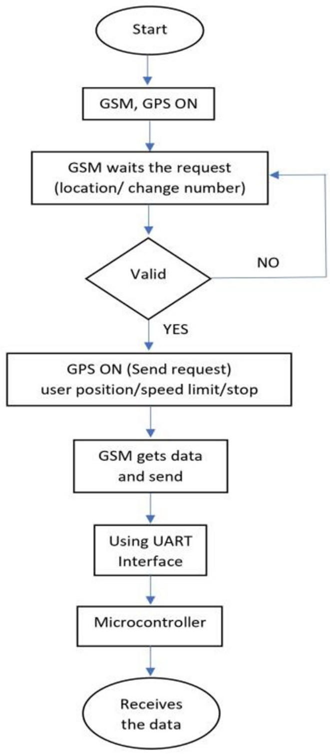

Fig.4. GPS and GSM Workflow

IV. RESULT

Our study results suggest that constructing a healthcare device for the diagnosis of heart attacks by integrating algorithms to identify sudden cardiac arrest improves accuracy and device performance. It provides an in-depth examination of the individual who wears the device; as a consequence, the result reveals improved detection of sudden cardiac arrest. We tested our gadget on cardiac patients as well as healthy persons. Thus, the final result demonstrates continuous monitoring of the patients' heart conditions, and once a problem is detected, the IoMT device sends an SMS labeled "Emergency" with the attached location of the user to the nearby ambulance and caregivers through GSM. The user can additionally designate one alert contact. After the SMS, it sends an audible warning call to a nearby ambulance via GSM shown in fig 5 and fig 6

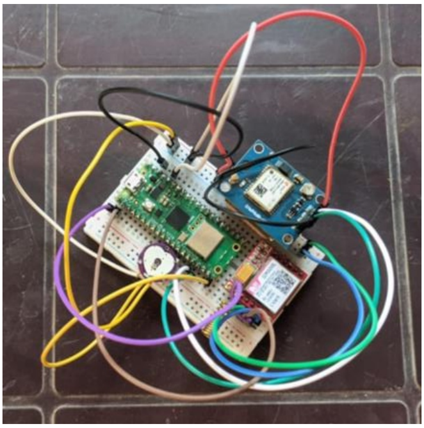

Fig 5: Hardware set-up of the system

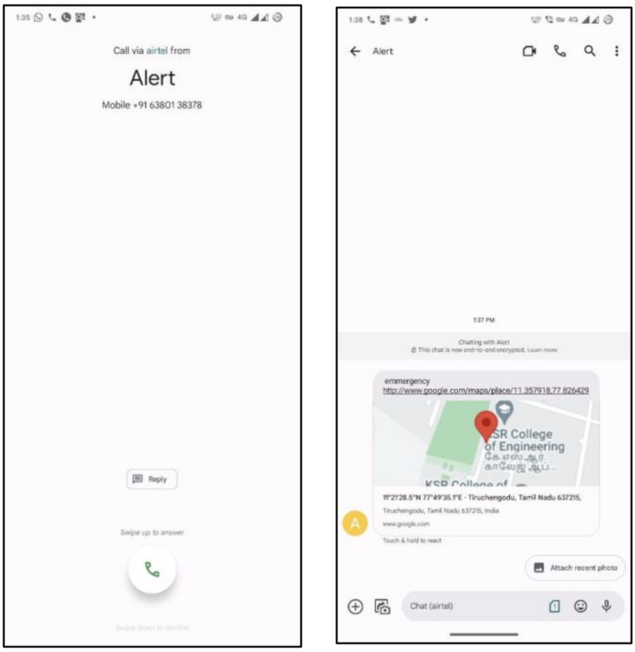

Fig.6.Emergency Bot call, Alert message notification with location

Conclusion

In this paper, Cardiac arrest has always been a problem, even currently of tremendous technological progress, according to this study. A seemingly healthy person of any age, race, ethnicity, or gender can suffer a cardiac arrest at anytime, anywhere, and with no warning. Cardiac arrest is the third leading cause of death, trailing only heart disease and cancer. Around 90% of cardiac arrest victims die before reaching the hospital, and four out of every five dies at home. We also propose a system that would function as a smart gadget for cardiac arrest monitoring, notifying the location of the subject who is in danger, and delivering a daily report to carers in order to save a member of the community's life.

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