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IoT Enabled Edge Computing Healthcare and Security System for Isolated Patients

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Abstract: ***The commonplace area healthcare Wi-Fi with cunning decisions, execute Wi-Fi communications era which could produce innovative communities. Wireless plays a top role in our everyday routine. Real-time Wi-Fi wireless tracking for initial detection of lifestyles alarming sicknesses via superior sensing and communique generation commonly contribute increase treatment to store the lives of sufferers. The principal goal of this assignment is to increase a gadget so as to deliver frame temp, MAX 30100 oxygen sensor and pulse sensor as nicely. Plus the Controller ESP32 board is interfaced with the sensors. For sufferers safety machine with the aid of using Python software and serially related laptop to ESP 32. Wi-Fi wireless facts transmission is processed the usage of Arduino via the module. The controller ESP32 is applied for wireless data transmission on IOT approach the usage of an android app BLYNK. Visually digitalizing the data on a Blynk Android App. patient`s record of statistics might be saved over a period of time. The statistics is stored using an Android app so one can manage the device the usage of the app.***

Keywords: IoT, Machine Learning, UART, LBPH

1. Introduction

Internet of Things (IOT) is a network of devices capable of exchanging data with other devices within the system or over the Internet. In recent years, if we take into account the fastest growing technologies in wireless communication, the IoT will be in the top positions. Devices can always be connected to the real world via IOT. Examples of real-time IoT applications are environmental monitoring, smart manufacturing, healthcare, transportation, etc. At present, postoperative patients or elderly patients or any other patients must be constantly monitored. When patients are monitored at home, they may not be receiving the correct medications because it may take their caregiver some time to understand the situation that may be wrong in the patient's health condition, which could lead to some problems. To check the patient's health condition, we need to consider various parameters such as temperature, heart rate, blood pressure, blood oxygen level, etc. To get this data, we need to use different devices for each of the health parameters. If the workers need to have their developed that continuously transmits these data in graphic form as well as in numerical value. The mobile application will be used by doctors and patients. The system will alert the physician by sending a notification to its mobile application when it detects the critical condition of the patient.

Furthermore, the accuracy of the artificial intelligence algorithms capable of interpreting IoMT data is remarkable. Various types of artificial intelligence algorithms have emerged, most notably deep learning (DL) algorithms, which have shown high accuracy in interpreting health-related data. State-of-the-art DL algorithms can even detect and recognize real-time camera phenomena or real-time IoMT sensory data. This introduced a new generation of IoMT compliant DL applications. A person's or hospital's data need not travel outside the owner's neighborhood or boundaries; rather, event and DL monitoring can reach the limit. This allows low-latency privacy, security, and data protection applications to run on user sites with the support of DL and IoMT. Therefore, Edge IoMT has given way to new DL paradigms, such as federated learning, where learning is done in a distributed fashion at the end, while only the model is distributed [5]. Inexpensive GPU hardware can support IoMT nodes acting as federated learning nodes. Edge computing delivers data processing capabilities directly to devices or gateway nodes closest to them. Open source platforms such as Arduino are widely used for prototyping IoT products, while artificial intelligence (AI) techniques are generally applied for data processing. Edge Computing shifts data processing directly to end devices, with connected sensors. This provides near real-time processing, lower latency, and can significantly relieve the pressure on the centralized cloud. Fog computing is located in the area between the end devices and the core of the system, [allowing for decentralized computing by processing data in the fog node. In addition to the computational capabilities, fog nodes must also have the facilities to store a certain amount of data. Recently, the fog paradigm has considered the possibility of transferring information technology to the edge of the network, relying on microcontrollers and sensors for computing activities, immediately after data collection.

2. Related Work

Yang et al. [1] used IoMT in the context of home physical therapy. IoMT was examined in the context of mobile edge computing in [4]. An overview of IoMT sensors in the context of patient monitoring was studied in [5]. A comprehensive health IoT survey based on the effect of the Internet of Nano Things and 5G Touch Internet on health service quality has been described [8]. The convergence of IoT and cloud was used by Alhussein et al. [7] to monitor the patient's health status in an IoT Cognitive Health Care (CHIoT) system. A review of the IoMT for pandemic management, such as COVID-19, was presented in [8]. Ahmed et al. [9] designed a framework capable of tracking social distancing and generating alerts in the event of a violation of social distancing.

The use of IoMT was investigated by Singh et al. [2]. In the collection of emotions of users who use IoMT was presented by using machine learning with IoT integrity. To help people with obesity manage their health, DL sentiment analysis system capable of understanding the patient's emotional state [10], [11]. Hossain and Ghulam described a system in which emotion is recognized by the Extreme Learning Machine (ELM) classifier. The system presented in the DL used to classify the activities of daily life was used.

A 5G-based edge learning framework for monitoring COVID-19 patients was presented in [1], where IoMT was used to monitor symptoms. To reduce the latency of IoMT inference and add privacy and security to IoMT data, the authors suggested edge inference [12], [13]. To avoid delays in bringing home critical patient health data, Hossain [5] proposed a cloud-based health monitoring system. Meanwhile, federated learning has been proposed to support edge learning in [3]. In another endeavor, edge-AI [6] was designed to support edge computing and mobile learning. Rahman et al. [9] proposed an edge computing framework to provide safe medical therapy [14] [15].

3. System Block Diagram

The proposed IoMT-based health monitoring system (Fig 1) was of the project. Arduino collects real-time health data from a pulse oximeter sensor which measures your heart rate in minutes or BPM (beats per minute), oxygen level. An Arduino digital temperature sensor measures the patient's body temperature. A temperature sensor is connected to Arduino to measure the ambient temperature so that we can adjust the room temperature according to our health and body temperature; Accelerometer used for fall detection is connected with arduinouno and NodeMc. For edge computing, use laptop having NVIDIA Graphics card which serially connect with arduino and NodeMC for intuder face detection. The buzzer emits beeps that are audible when the face is detected. Uncommon heartbeat can be detected by hearing only the beeps. The standard ESP32IoT module connects to Arduino via UART, is responsible for connecting the machine to the Internet and sending health data to the IoT (Thing speak) Server for archiving and monitoring. Monitoring patient's information through Blynk mobile app. This is useful for healthcare professionals who actively monitor the patient on site.

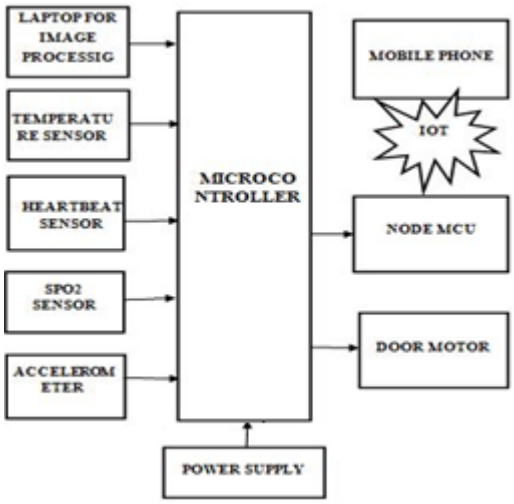

Figure 1: System block diagram

The laptop connected in series to the microcontroller Build deep learning applications for patient safety, such as intruder face detection. Machine learning with live video. All information collected from patients by the microcontroller is sent via the IoT device to the receiver side. Using the Blink app, all information can be monitored by doctors, healthcare professionals, relatives. Includes physiological information and safety information's.

4. System Model

Figure 2: IoT based health and security system monitoring model

The proposed wellbeing following gadget form the utilize of IoT is demonstrated in Fig.2. Our paper is developed from each equipment and computer program. In equipment portion, pulse, SpO2 and Temperature sensors are utilized. When the pulse, SpO2 and temperature are measured. Program portion incorporate tactile program upgrading utilizing Arduino IDE and real-time confront acknowledgment by python openCV. Wi-Fi module permits to send all information to Blynk app utilizing Blynk server and can screen that entire data utilizing versatile phone.

Hardware Implementation

We implement (Fig 4) all the sensory information collected from the patient on the arduino Uno using the arduinouno IDE software. Arduino IDE is open source software used to write and load code on Arduino boards. The IDE application is suitable for different operating systems such as Windows,

Mac OS X and Linux. It supports C and C ++ programming languages. Here, IDE stands for Integrated Development Environment.

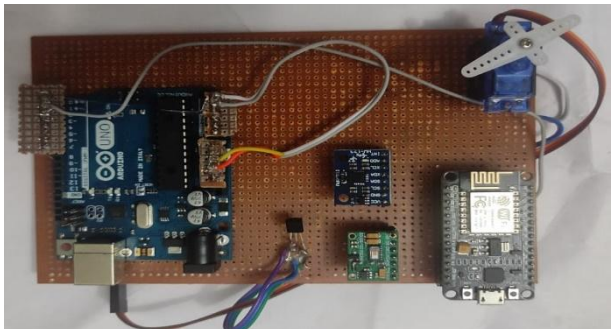

Figure 4: Hardware implementation

Software Design

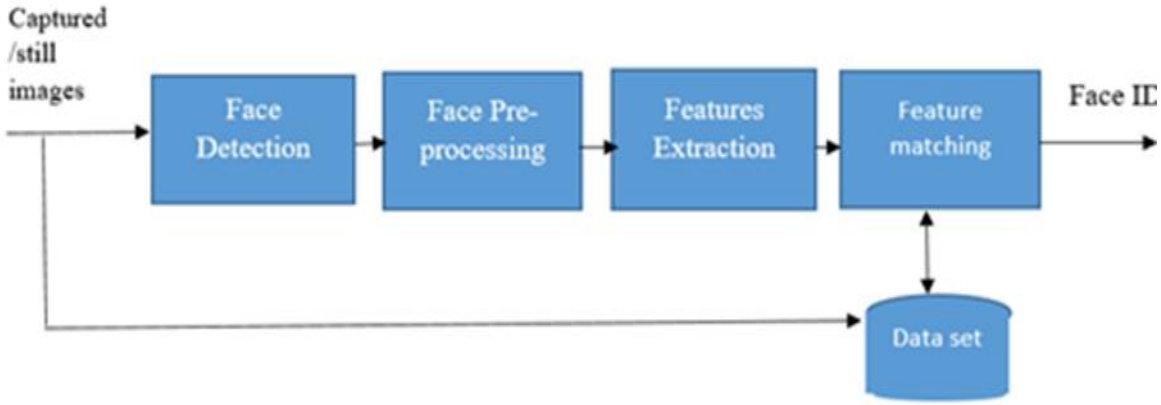

Figure 5.1: Basic phases in intruder Face detection system for patient's security monitoring

Computer program segment primarily incorporate python OpenCV machine learning calculation. In this extend, confront discovery calculations are progressed fundamentally based completely on Nearby Double Designs Histogram (LBPH). The LBPH-primarily based completely calculation, step one is to extricate the photo test with the LBPH calculation. At that point, limits are set to calculate the opportunity of confront with interior the photo test. After that, the sliding window executed to gotten to be mindful of the faces in given photos and secure the ones faces. The fundamental LBPH based confront discovery utilizing python openCV appeared in Fig.5.1

A. Local Binary Patterns Histogram

Based on the picture handling procedure (Fig.5.2), let's break it into a few little steps so able to get it it easily: Suppose we have a facial picture in grayscale. We will get portion of this picture as a window of 3x3 pixels. It can also be spoken to as a 3x3 lattice containing the escalated of each pixel (0~255). At that point, we have to be take the central esteem of the lattice to be utilized as the edge. This esteem will be utilized to characterize the unused values from the 8 neighbors. For each neighbor of the central esteem (limit), we set a unused double esteem. We set 1 for values equal or higher than the edge and for values lower than the limit. Presently, the framework will contain as it were parallel values (disregarding the central esteem). We have to be concatenate each parallel esteem from each position from the lattice line by line into a unused twofold esteem (e. g.10001101). Note: a few creators utilize other approaches to concatenate the double values (e. g. clockwise heading), but the ultimate result will be the same. We have to be concatenate each twofold esteem from each position from the framework line by line into a modern parallel esteem (e. g.10001101).

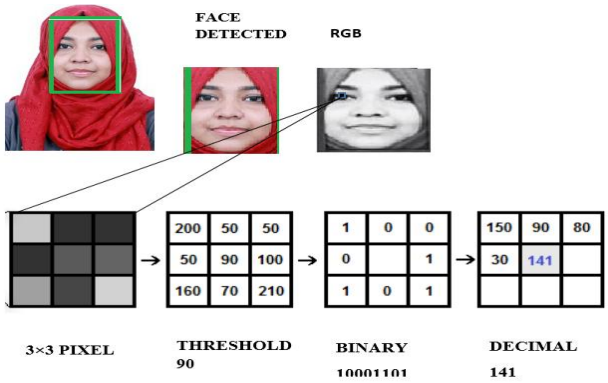

Figure 6: Image processing using LBPH

5. Test Results

We utilize microcontroller, arduino board for IoT execution, we ought to utilize a partitioned Wi-Fi module. In our strategy we utilize NodeMCU which is an open source firmware and improvement pack and is suitable for IoT. The fundamental advantage of NodeMCU could be a microcontroller which combines the characteristics of WIFI and microcontroller. SpO2, temperature, accelerometer, ADXL sensor and flicker sensors associated to NodMCU. This information is then uploaded utilizing the ESP 35 Wifi module on the IOT. Utilizing the discontinuous application we are able screen the quiet and the environment. The genuine time result is as appeared in Fig 6.1

Figure 6.1: Health Parameters shown in Gauge form under normal condition

This segment is appeared underneath in Fig.6.1 of patient's wellbeing beneath typical condition as a result of equipment section. Under ordinary conditions, all wellbeing parameters were inside typical limits: ordinary beat 84 beats per miniature (bpm), typical SpO2 94% and typical body temperature 33.550C for a solid grown-up.

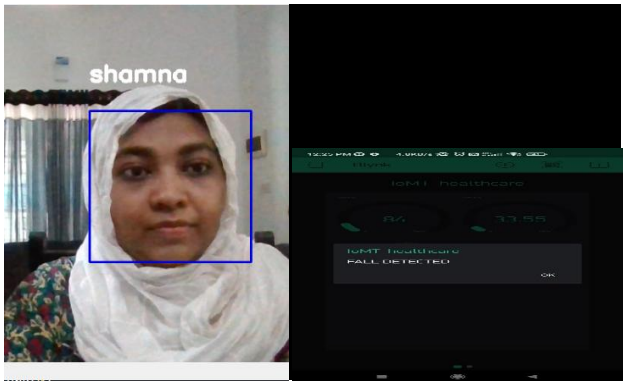

Figure: Result of face recognition system using ML in Python openCV (6.2 (a) left) Face recognition result send to Mobile app (6.2 (b) right)

In this application, the calculation connected to confront acknowledgment is partitioned into three diverse and free parts. After preprocessing, all 50 previews of objects will be put away within the same envelope. Each picture will be allotted a subject ID and test number. Test check is the number of pictures per confront picture. Subsequently, the test number will be diverse, whereas the subject ID will be the same for a confront picture. If the person before the camera is known at that point title of the individual show on the live camera picture (Fig: 6.2 (a)) and send a message to understanding relatives through IoT Versatile app appeared in Fig.6.2 (b).

6. Conclusion

In this article, we present an effective compute framework that takes advantage of the IoT deployed in the user's perimeter environment, such as the home. The edge nodes use a prototype edge module with a laptop connected in series, allowing applications to collect safety and physiological information from patients. With the edge architecture, privacy, security and low latency of user data have been achieved. Also reduce the cost of the healthcare system by using low-cost devices. Due to the shortage of specialized doctors and travel restrictions due to the pandemic, particularly for the elderly, home healthcare and symptom management would provide the next generation of healthcare. As a future work, we plan to improve the accuracy of each app and implement it on real topics.

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