Iot And WSN Based Smart Surveillance System For Patients With Closed-Loop Alarm

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Abstract: A smart surveillance system for patients is an emerging subject in the current time for health and safety patient's life in a remote location. In patient's surveillance system, sensor devices have an important function to communicate, collect data and analyze it for real-time applications. The precondition of the patient can be monitored and analyzed by using the various body sensors such as Spo2, Pulse, acceleration, temperature, etc. Sensors can be utilized to collect data from patient's body and send it to the remote location for analysis. This data can be used in the real-time application for monitoring the patients in a remote location. This paper discusses the state-of-art technologies that have been employed in literature for Smart surveillance system for patients. Also, the authors offered a novel architecture for a patient surveillance system that utilizes the concept of IoT (Internet of things) and WSNs (Wireless sensors networks). The proposed architecture acts as a surveillance system to monitor the patients with a closed-loop alarm which further help the concerned authorities to take the necessary and immediate action.

Keywords: Internet of Things, WSN, remote health monitoring system, smart surveillance system

1 INTRODUCTION

Internet of Things (IoT) is the huge network consists of electronics devices such as home appliances, vehicles, mobile phones, and many more smart objects. IoT has grabbed a reputed position in the field of technology. These days IoT is being used for almost every field that could be related to the research area, health science, security system or manufacturing of any devices. In short, IoT has made daily life easier and more reliable to live [1-2]. The major features of IoT are storing sensor data in real-time, sending real-time data in the cloud, accessing those data from anywhere [3]. The real-time data of sensor is stored by using any Wi-Fi module like NodeMCU, or Bluetooth modules like HC-05 with the help of Micro-controller or Microprocessor. As IoT grabbed a huge position over technology, on other side use of Wireless Sensor Networks (WSNs) has grown rapidly. Today's application based on network computing is faced with a huge demand for powerful functionalities network. The reach of the functional network is fundamental to customer satisfaction both in cloud computing as well as mobile network environments [24-26]. WSNs is a wireless network consisting of spatially scattered independent devices using sensors to continuously monitor environmental or physical conditions, such as sound, temperature, pressure, vibration, pollutants or motion, at various different locations [4-5]. A collection of sensing devices that can communicate wirelessly [6, 23]. By this generation of technology, sensors have become the most important object [4, 20-22]. Sensors are small in size but highly perfect for the features of sensing motion, pressure, and human touch even the atmosphere temperature [27]. The size and lightweight make the best advantages of sensors that help to design a device. The fetched data of sensors are processed with the help of an open-source programming language name Python [2,5]. Python is an open-source programming language which can be used to create computer software [6,28]. ThingSpeak is a cloud-based platform is used to store the sensor data in the cloud where ThingSpeak is also an open-source platform based on the cloud [4-5]. The motivation is to implement experimentation based on IoT and WSNs based smart surveillance system for patients with closed-loop alarm. The implementation of fetching real-time data of various wireless sensors and storing those data in a cloud-based platform. Various sensors used to measure pulse, acceleration, Spo2 and Temperature were used for this experiment. Purpose of using the pulse sensor is to detect the heart rate. Acceleration sensor to detect the movement or acceleration. Spo2 is used to evaluate the amount of oxygen present in the blood, or simply the percentage of hemoglobin contains oxygen. The temperature sensor is used to detect the body temperature. Before sending any data in cloud-first the data in real-time need to be fetched from the sensors. The outputs of fetched data in real-time were store in the cloud and shown in Android application in a closed loop. By the end, the experimental results are explained briefly. In this article, at first, we address several patients monitoring system based on IoT and WSNs. Then we propose a smart surveillance system for patients with closed-loop using IoT and WSNs. Therefore, the remainder of the article is organized as follows, starting with an introduction in Section 1. Section 2 is committed to the existing literature. Section 3 is defining the problem. Section 4 introduces the proposed work to monitor the patients. Section 5 finishes up the paper.

2 LITERATURE REVIEW

In this section, there is a summarization of the existing literature which has already done in the field of IoT and WSNs. The aim of reviewing the literature is to gather the objective of the research available on the application of IoT and WSNs by evaluating results as per the study approaches (Sethi, S., and Sahoo, R. K. 2019) have designed an application on Health monitoring system (HMS) based on WSNs in real-time, and further continually monitoring and updates data for medical records [7]. (Modieginyane, et al. 2018) have proposed an application challenge of WSNs to monitor the environment as well as those challenges faced by approaches and opportunities. This paper elaborated with the help of SDN how approaches and opportunities can be released on the applications of WSNs [8]. (AlSkaif, T., et al. 2017) Another research related to smart cities as well as environmental monitoring in four specific applications the researchers compared the energy consumption of MAC protocols. The researchers used a traffic model of multi-class to analyze the energy consumption of the MAC protocol in a low data rate [9]. (Miqdad, A., et al. 2017) The development of a real-time data acquisition module of Humid and temperature sensor using DHT11 and NodeMCU. The sensors data deployed in to sensing the building space, monitoring and recording the data of temperature, humidity or air quality, studied by the researcher [10]. (Chandra, et al. 2017) A paper described how the multi-agent system of an electrical plant can be organized by dynamically in the community of problem-solving based on IoT. The researchers have explored the monitoring and how the IoT paradigm cab is controlled [11]. (Xie, G., et al. 2017) A Research paper focused on providing a routing mechanism of energy-efficient with obstacles for the WSNs by assuming the Mobile Data Collector (MDC) as a low rate to get data from static sensors [12]. (Zakaria, Y, and Michael, K. 2017) To monitor pH based on an integrated cloud a paper introduced a prototype of WSNs which also provides a solution to dissolve oxygen parameter from wastewater. The prototype has a platform name Tele rivet messaging which not only can identify water pollution even sends notification via SMS [13]. (Simoes, N. A., and de Souza, G. B 2016) The researchers discussed the communication of Data Acquisition System (DAS) to 52° North SOS. The authors introduced an approach to make a low-cost automatic DAS that will obtain urban sites data of temperature and humidity. For the approach authors provided the complete infrastructure to data visualization in the actual context of big data and based on IoT [14]. (Misra, S., et al. 2014) A study on the mathematical formulation of sensor cloud based on characteristics of virtualization. As per the results, the authors declared the sensor's lifetime increased by 3.25% and consumptions of energy decreased by 36.68% [15]. (Hackmann, G., et al. 2013) The paper integrated with two approaches, one is the damage localization method based on the flexibility that allows a trade-off between several sensors and resolution. Another one is about flexibility-based energy-efficiency, the architecture of multilevel computing designed. The authors explained an experiment of simulated truss structure as well as a real full-scale structure that demonstrate the efficiency of a system in energy-efficiency and damage localization [16]. (Kothari, D., et al. 2013) The other authors reviewed of developments of WSNs, applications of WSNs, design constraints including lifetime estimation model. They also introduced the techniques of NL (Network Lifetime) maximization with design guidelines [17]. (Mitra, U., et al. 2012) A system based on the end-to-end body area sensing name KNOWME integrated with Nokia N95 mobile phone. The purpose of that paper was to monitor and evaluate four major challenges of physical activities [18]. (Patel, S., et al. 2012) A study focused on the recent developments of wearable sensors and its applications which include health and wellness, safety for the human body, early detection of the disorder [19].

Table 1. *The technique used by different authors in the existing literature*

Publications	Technology Used	Description
[7-10], [12-13], [15-17]	WSNs	It is a wireless network, which consists of scattered independent devices, utilizing sensors to continuous monitor environmental or physical conditions.
[7]	Body sensor network (BSN)	BSN consist of various sensors appended to a patient in order to collect physiological information. Conventional wired BSNs have been utilized in medical clinics throughout the most recent decades; moreover, these sensors system does not allow the patient to move freely.
[8]	Software defined networking (SDN)	SDN is an evolving architecture that is manageable, adaptable, dynamic and cost-effective, which makes it perfect for today's application which required high bandwidth.
[9]	Wireless Multimedia Sensor Networks (WMSNs)	WMSNs are currently a new and growing technology in sensor networks. the sensor nodes consist of microphones, cameras, and various different sensors generating multimedia data. These systems can possibly empower a huge class of applications.
[11], [13]	IoT	IoT is a combination of physical devices and software's, electronics to communicate over the internet.
[12]	Mobile Data Collector (MDC)	MDC is a processor of compiling quantitative and qualitative data with the help of a portable device (e.g. mobile phone, tablet, etc.). This approach has been confirmed to increase the

Publications	Technology Used	Description
		accuracy and speed of collecting the data.
[18]	Wireless body area networks (WBANs)	WBAN is connected with autonomous hubs or sensors that are attached to the body of an individual. The system normally extends over the entire human body and is occasionally extend using hubs that are situated within the body. further the hubs in interconnected with each other through a wireless medium in a central processing unit.

3 PROBLEM DEFINITION

Motivated by the lack of sufficient research in the area of the smart surveillance system for patients with closed-loop alarm in the field of WSNs. We started with the basic question: which sensors are required to monitor the vital signs and what application is used to monitor the patient in real-time? We found that all the devices are having one or two sensors attached to monitor the patients. Further lack of closed-loop alarm system presents in monitoring the patients. This work, therefore, intends to "Increase the possibility of measuring various vital signs data using a single device. Also, it is providing a closed-loop application to monitor the patients in real-time". Hence the device will be reliable for monitoring and data collecting of patients in real-time.

4 PROPOSED WORK

Based on the existing literature, this study proposed the enhanced system for monitoring patients with closed-loop alarm with the help of WSNs and IoT. In this system, the author has used four sensors (Accelerometer, Spo2, Pulse, and Temperature) to monitor the patients in three different steps. The first step was to perform the connectivity of all sensors together to get one output. The second step is to send collected output in the cloud. Finally, the third step is building an android application which shows the output of the patients in a closed loop in real-time. Below figure number 1 shows the architecture of the proposed model.

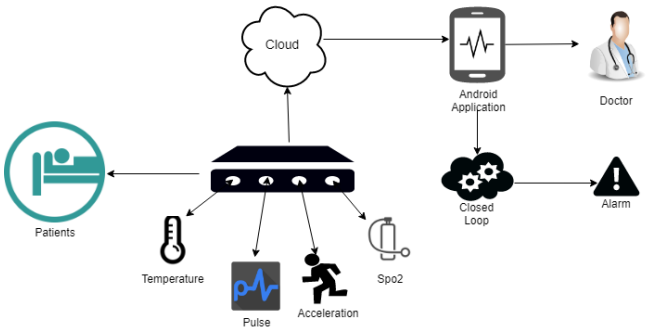

Figure 1. *Architecture of the proposed model*

In the first phase, the user will wear a wearable device, the device consists of four sensors in it (Accelerometer, Spo2, Pulse, and Temperature). Sensors continuously collect the data from the patients, then send the respective data to cloud-based platform thingspeak. The data stored in thingspeak is either public or private channels which further can share with anyone via emails or API keys. Secondly, using API keys the data is sent to an android application, in JSON format which can be read by the doctor on a continuous basis. At last, the application also consists of the closed-loop alarm based system. The closed-loop system is set with some upper and lower bound limit, if the reading goes beyond this it will raise an alarm through which the concerned authorities can take the necessary and immediate action

5 CONCLUSION

In this paper, various advanced techniques based on the patient's health monitoring system offered by different authors since the last few years have been studied. The innovations are changing the era speedily; however, the issue stays due to ever increment in the technology. We found that even though most of the popular IoT and WSNs based patients monitoring system acknowledge the issue of real-time data transfer and analysis it. Finally, we proposed a smart surveillance system for patient monitoring based on IoT and WSNs, which can efficiently and reliably analyze, monitor of collected data in the real-time application with closed -loop.

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