Automation in Healthcare Systems

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Abstract. Due to sudden natural/man-made incidents, there are more and more health problems in the world. Another concrete example is COVID19 where hospitals are operating beyond capacity. Even doctors are not available on time. The other category includes people who are suffering from long time or urgent decease and need constant monitoring and medication. One way is to provide continuous remote monitoring and automated medication delivery to a specific patient, who can play a very important role in such cases as well as providing required support to patient as well as medication system. In this review paper, the essential patient's health-related data will be observed and streamed for decision making and parameters such as oxygen, saline flow and other medication can be controlled automatically. This paper also introduces the method of monitoring pulse rate, blood pressure, oxygen consumption, blood sugar, ECG like parameters.

Keywords: Remote Sensing · Remote Controlling · Transmitter · Receiver

1 Introduction

Day by day the health issues are increasing. This is due to life style, nature or instant incidents occurs like heart attack, accidents, paralysis and many more. The latest live example is of COVID19 which made complete system totally paralyzed. By view of such changes, there are so many systems developed by scientist to monitor the various parameters of the patient through various communication systems. Some of them are noted.

BP, EEG, ECG, Body temperature and pulse rate measurement and remote monitoring is achieved by means of IOT based transmission system [1]. The accuracy achieved in the system is more than 97% (Fig. 1).

The learning architecture consists of the following modules.

(1) Monitoring Unit: An intelligent sensor array with my-RIO processor.
(2) Processing Unit: my-RIO wireless transmission using Wi-Fi module that was enabled.
(3) Visualization and Storage Unit: IoT gateway for data visualization for processing.
(4) Learning Unit: Signal feature prediction and notification module.

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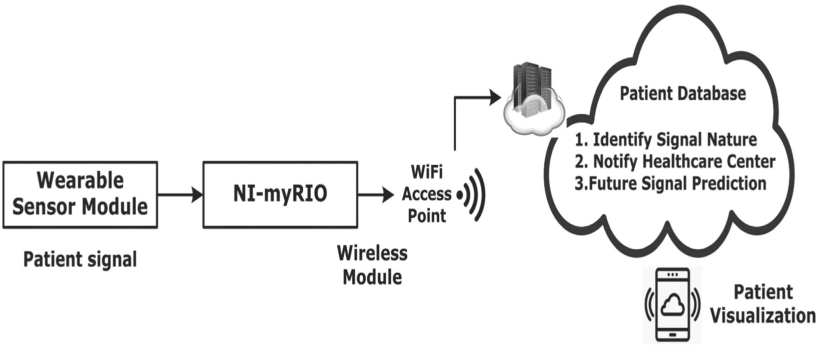

Fig. 1. Architecture of signal monitoring system using the Deep Learning Network [1]

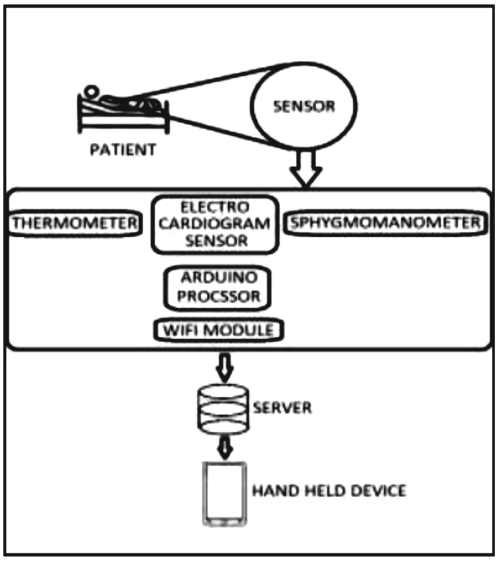

Fig. 2. Architecture [2]

The second method is also based on IOT, but this system gives intimation when parameters go beyond the required range. The device send alert automatically to the patent and control system in emergency. This system is build using the interface of thermometer, sphygmomanometer and electro-cardiogram sensor to Arduino. The wireless communication using a wi-fi module is achieved with server to server and then to the remote display device (Fig. 2).

With the help of sensors, the proposed system is able to track the basic vitals like temperature, blood pressure, heartbeat rate and Electrocardiogram readings of patients at home or remote site. The user can remotely monitor the live status of the patient from anyplace with the only constraint that there should be internet connectivity as to receive

the live updates about the patient. The proposed model is extremely useful for the society and would supplement the existing solutions for health monitoring [2, 3].

The above system is proposed for better communication using 5G technology to transmit the information from patient side to display side very speedily. Surely the decision making for meditation will be recovered and accurately control over the system will be in practical as compare to other communication media [4].

Other side, the health monitoring systems are again more powerful by making the sensors very small in size so that even they can be wearable on the body and can give more accurate result. Such sensors are adopted to design health monitoring system. The complete circuit with sensors is mountable on a jacket and placed on the patient's body and operated with battery inside. The advantage of such system is such that patient can have his daily routine and not necessarily to stuck on bed permanently. In such condition the patient who has advised to do regular work, such persons can easily monitor remotely [6].

In recent years, so many research work is proposed for remote-assisted advance ireless real-time patient monitoring systems [21–29] but they have don't put the controlling of parameters. For example, in most of the hospitals, doctors' cabin and admitted patient's room have large distance. Even some time it may happen that due to long distance as doctor not able to reach to patient the patient may get very serious or can be loss of life.

It will be very helpful when such system can be able to control meditation. The doctor can turn on/off saline, which is already attached to multi way stopcock port. The advantage is that, as soon as patient need urgent meditation on his bed, doctor can remotely turn on saline and like meditation which are connected to various ports of multi way stopcock. In some cases, the oxygen supply can also be made on/off depending on the patient's condition.

In this article we proposed the controllable system for direct medication, which can be observed and controllable directly from practitioner. Several injectable medicines can be connected with the help of multi way electromagnetic stopcock and in emergency particular valve can be operate for particular medicine to be injected to patient. The motorized electric valve can be put in for controlling of oxygen supply. The position of the valve can be observable on the controlling display. The system gives feedback to practitioner about the various parameters like heart rate, Blood pressure, ECG, Blood sugar, EEG, Body temperature, and many more specialized parameters with the help of wearable sensors and transmitting media. The transmitting media can be wireless or with the help of wire.

2 Architecture

With improvements in health care systems the sensors are wearable. The volume and flexibility are so high that one can even print the sensor on body. The proposed system consists of transmitter and receiver circuitry.

With the help of wearable sensors (Temperature, ECG, EMG, Blood Sugar, Blood Pressure, Pulse Sensor, O_2 Sensor, Electronic Stethoscope and special sensor if any) controller unit placed as signal conditioning and interfacing unit transmit body parameters to the remote as well local display unit interfaced with controller unit. The complete

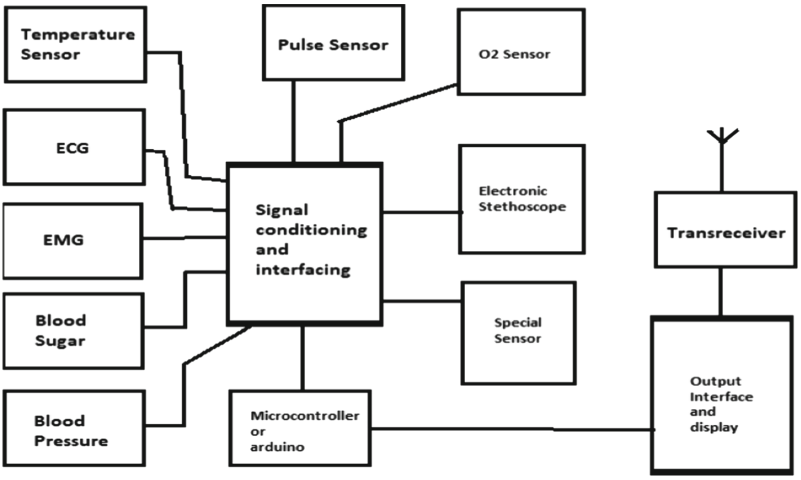

Fig. 3. Patient monitoring & control module

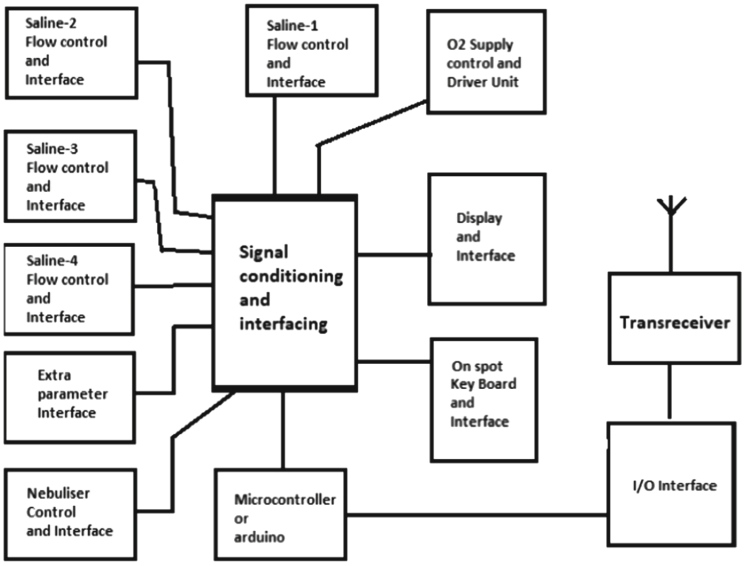

Fig. 4. Control Unit

operation control and processing is handled by signal conditioning & interfacing unit as well as controller unit. The controller unit can be microcontroller, Arduino or can be any one which can able to handle such signals. The well-polished signals are then transmitted using trans receiver for observation and designing making at doctor's end. Depending on the requirement this transmitter can be made using GPRS, Zig-bee, RF transmitter, Blue-tooth and other trans-receiver module (Fig. 3).

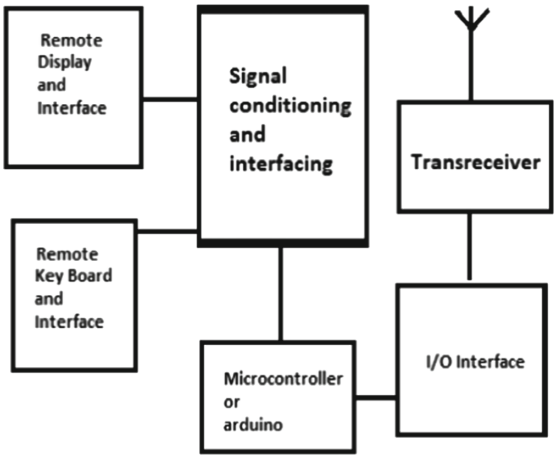

Fig. 5. Distance monitoring & Control

Figure 4 shows the controlling unit at patient's end. This circuit is employed as a main control unit which will make or control flow of various medicines connected for emergency as a lifesaving drugs. Each separate flow control and interface consist of timer, adjustable valve with position control using motor and actuator, motor driver and pulse generator circuit. Trans receiver receives signal from the doctor's module and forward the signal to controller unit. Controller unit analyze the signal and apply hold on particular flow control and interface unit. The unit can manually be controlled at the patient's end with the help of keyboard interfaced to control unit. The applied command and result can be observed on local display connected to signal conditioning circuit.

The above both systems are at patient's end out of which patient monitoring & control module is with the patient. At this point patient is also in-vented multi-flow-controlled injection module. The control unit is attached to life saving drug interface module. Figure 5 shows the observation and decision-control module. This unit is with practitioner. The trans-receiver receives as well as transmit signals to and from the device. After received signal the status of the various sensors are placed on display. If the range of the received signals is beyond the normal range the intimation in the form of blinking display, vibration or sound will be placed to attend the required action from the practitioner. As soon as such event occurs the decision for emergency drug supplying is finalized and particular command is passed from doctor's monitoring and control unit to control unit at patient's end. After giving command the same is observed for execution from the control unit by checking the various parameters respect to patient.

3 Conclusion

Most of the systems developed earlier are only for observing medical parameters. Those systems are based on various microcontrollers as well as various communication channel. The most efficient system can be develop using IOT which will easily monitored as well as controlled also.

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