Journal of Namibian Studies, 35 S1 (2023): 1067-1080 ISSN: 2197-5523 (online)

Digital Medical Assistant System Using Iot

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Abstract

Automated medical assistant systems with less or no human interventions are very much important during pandemic situations to prevent the spread of highly contagious diseases like COVID. During critical situations the number of patients requiring immediate medical assistants rises exponentially in a shorter period of time and providing assistants to all at the same time will be a practically difficult. This warrants for an automated system to perform preliminary examinations of the patients without human intervention. In rural areas availability of doctors will be less and diagnosing the disease at the earlier stage turns out to be difficult. The proposed Digital Medical Assistant System (DMAS) is to enable people to observe their health parameters via kiosks in public locations like pharmacy stores, malls, bus/railway stops, on highways, and other places. This prototype prevents the serious risks of patients before they reach the hospital. People will receive a prescription for preliminary medication through text message to their

registered mobile number, which is a significant benefit of this system. Further it will advise the patient to see a doctor for further treatment based on the severity of symptoms. Cloud-based database stores the patient's medical history for future access. Comparative analysis with the other voice based medical assistant and direct visit to hospitals, this system performs better and only 11.9% of patients are visiting hospitals for further treatment. Since the diagnosis is made early and the recommendation for subsequent treatment is given immediately, fatality rate is lowered significantly.

Keywords: Pandemic, Medical assistant, Diagnosis, Cloud, automated diagnosis.

1 INTRODUCTION

The main objective of World Health Organization is to ensure Healthy living to the mankind by coordinating the health services[2].To keep themselves fit and healthy they have to make use of modern health care system[9][15]. In the field of medicine Wireless transmission media[12] ensures safety, speed and installation of hardware is easy and at a lower cost. In hospitals, for monitoring the patients physiological values continuous, monitoring systems are used. In these systems sensors[13] are 'hardwired' to the monitors or PCs nearby the patient. Despite wired availability with the observing gadgets, nursing staff should monitor all important values by making note of the records manually into the PCs which would at some point will make human blunders and result in serious consequences on the patient.

In this work, measurement of body temperature, heartbeat , respiration and SpO2 level has been demonstrated and data is transmitted based on ZigBee using two transceivers without wires. One transceiver is connected to a low cost Raspberry Pi and the other is connected to Aurdino microcontroller board which senses the temperature and acts as a simulator for a medical equipment.

The main objective is to design a real-time monitoring system for a patient by measuring the temperature, heartbeat, respiration and SpO2 level. In addition to this preliminary medications are also recommended to the patients. This system

works with low power consumption and at a low cost. This will work with the doctor who might be on travel or from his/her medical clinic to screen the patient for ailment. Furthermore, the framework incorporates saving of time and exertion of the clinical staff (doctor and attendants), quality improvement of patient consideration and decreases the error rate of humans. The framework estimates the fundamental physiological values (for example temperature) and sends cautions making alert for clinical staff to go to the patient for crisis. Additionally the framework makes it conceivable to transmit the information and save naturally for future reference.

2 LITERATURE SURVEY

To analyse the monitored data in health care system Mdhaffar, Afef & Chaari, Tarak & Larbi, Kaoutharet.al[8]have used low power WAN network. Upto the range of 33m^2at around 12m altitude they established a WAN network for communication. These authors have stated that LoRaWAN network consumes ten times less power than the GPRS/3G/4G. This network's main purpose is to consume less energy. In idle mode LoRaWAN network power consumption is 2.8mA while in GPRS is 20mA. LoRaWANs maximum data rate is 50kbps (uplink) and 50 kbps(downlink)while in GPRS it is 86.5kbps(uplink) 14kbps (downlink). They have given the results of the overall efficiency of LoRaWAN in health monitoring system using IoT.

Telemonitoring framework by means of WBAN is advancing for the requirement for locally established portable wellbeing and customized medication. WBAN had the option to gather the information gained from sensor and record the output. This output results are transferred wirelessly to the controller of the health monitoring system. Since Zigbee guaranteed delay requirement in health telemonitoring system it was used in WBAN technology too. [18].

Mohammad M. Masud, Mohamed Adel Serhani, and Alramzana Nujum Navaz[11]have measured ECG signals in different situations at various levels. They have considered energy aware, restricted computing resource and lose in the network coherence challenges. Numerical model has been created to execute each undertaking consecutively. Three approaches

have been designed to work out the process as one in mobile based monitoring approach, second in data mining and third with machine learning approach.

Ayush Bansal , Sunil Kumar, Anurag Bajpa et.al.[1]developed a system for detecting critical cardiac events. They have focused on development of a system with advanced remote monitoring system which is capable of detecting critical cardiac events. Present day medical care framework presents new advancements like wearable devices or cloud of things[14][4]. By storing patient-monitored data and transmitting it via IoT, it offers flexibility. A secured data transmission is required for this connectivity. The objective of this research is to transmit the data with privacy is the Moto of this paper. They have proposed a system which ensures security in health care. The storage stage and the data retrieval stage are the two main components of the system's operation. In the storage stage, data is updated and stored for future use. Data is retrieved from the cloud during the data retrieval stage. Data can be shared authentically as requested. Using GSM and 3G, the data is transmitted to the cloud server.

3 DIGITAL MEDICAL ASSISTANT SYSTEM

Prime parameters for diagnosing the diseases are body temperature, heart rate, blood pressure, respiration rate. The proposed system gives temperature, heart rate values, blood pressure and respiration rate using IoT. For many decades Medical scientists are trying to have many innovation and research in the field medicine to give better health services to human lives[7][16]. System architecture[10]represents the conceptual model and behavior. Architecture diagram of DMAS is shown in Fig. 1.

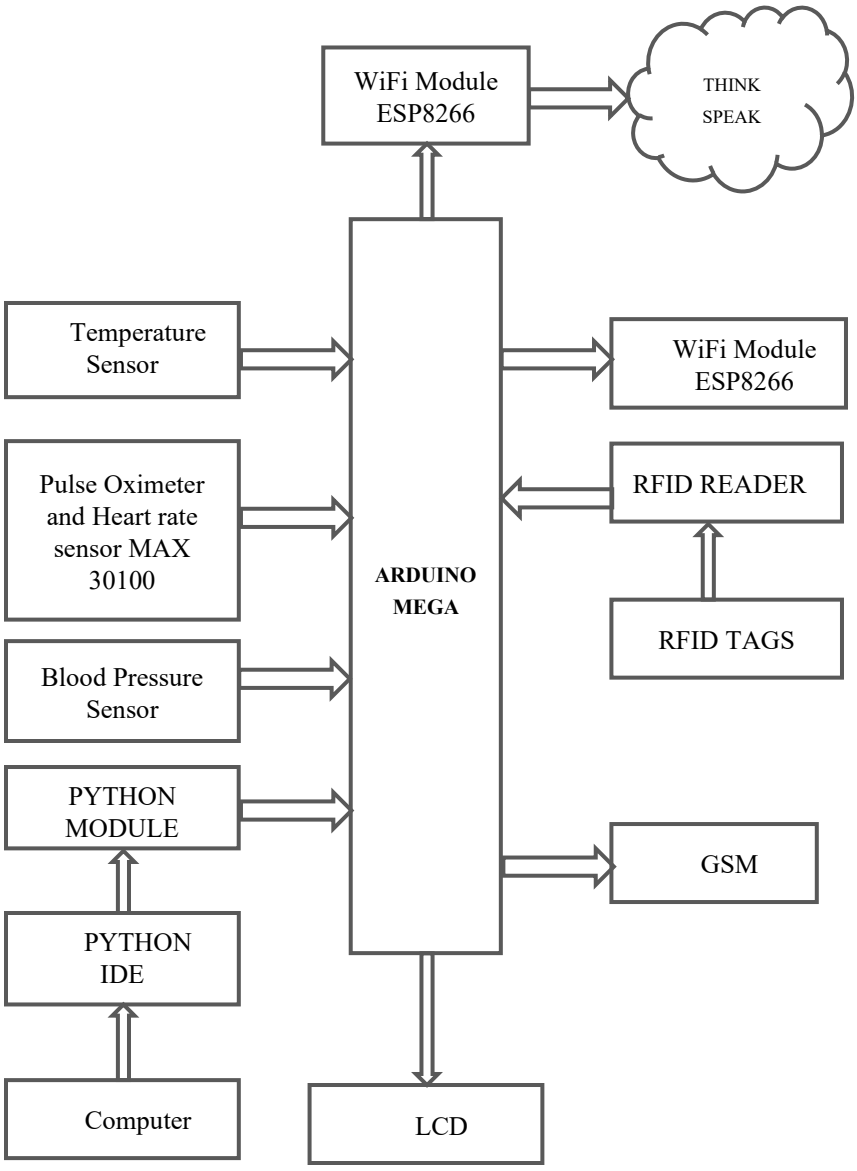


Fig. 1: Architecture of Digital Medical Assistant System

Details of new patients are registered through the computer connected to the KIOSK and is sent to the Microcontroller. RFID tags are provided during registration. Same patient can access any KIOSK available at different places and perform health check-up using the RFID tag. Temperature, blood pressure, heart beat and SPO_2 sensors are connected to the microcontroller. PYTHON module is loaded onto the ARDUINO boards for processing the parameter values read from the different sensors. Preliminary medicines[5] are prescribed by the system to prevent the patient from further deterioration before reaching to the nearest hospital. All parameter values

along with the geo-location details are stored in cloud storage which can be accessed from any place for further reference and treatment.

3.1 Functioning of Digital Medical Assistant

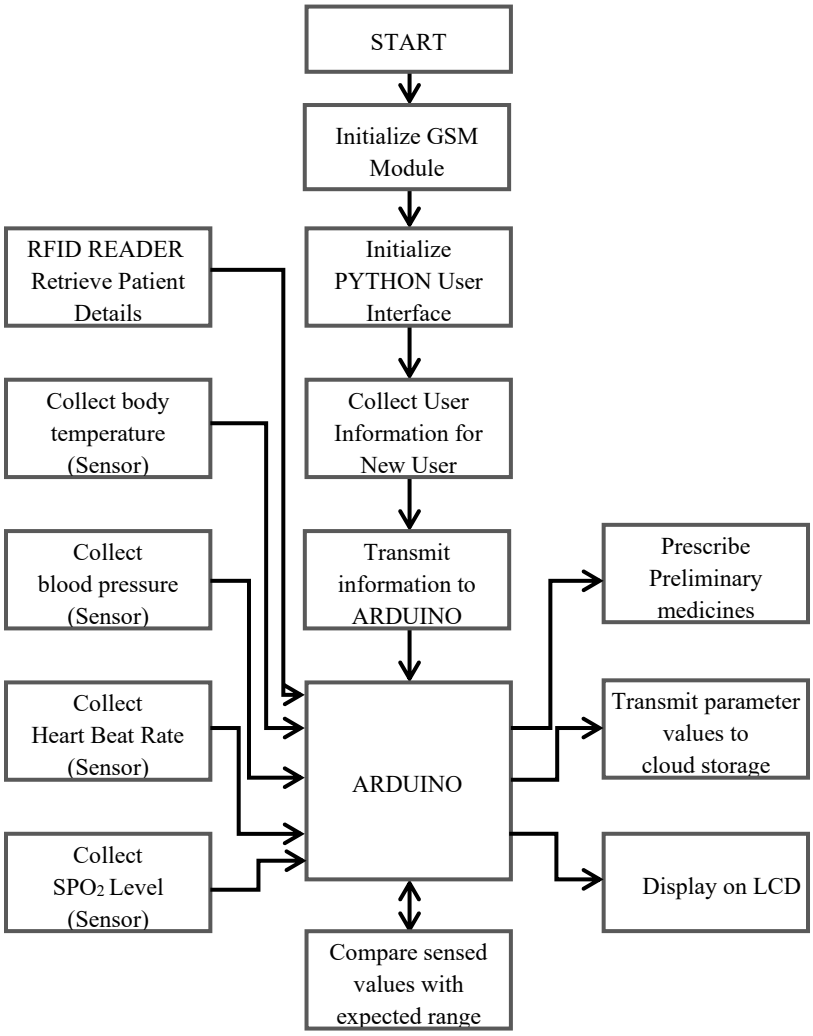


Fig. 2: Functioning of Digital Medical Assistant

Complete functioning of the system is presented in the **Fig.** 2 which indicates the kind of input, output from the system and where the data will be stored.

GSM module of the system is initialized with its parameters related to the physical location of the KIOSK. The physical location can be chosen as the hospital front office, School or

college health centers, bus stand, railway station, airport or some common place in the rural villages too.

New patients have to register[6]their details like name, date of birth, age, AADHAR number, phone number and mail id. RFID tags will be generated for the new patients. For the subsequent visits to the KIOSK for health check-up, patients require to show the RFID tag to the RFID reader to ensure contactless operations. Data related to the patient will be retrieved from cloud storage during processing. Through the sensors present in the KIOSK, temperature, blood pressure, heart beat and SPO2 levels are collected automatically without any human intervention. These parameter values are compared with the range of normal values. For any abnormalities detected in the collected parameters, the patient is prescribed with the first-aid medicines to prevent from further health risk before reaching to the nearest hospital. Collected parameter values are displayed in the LCD panel attached to the microcontroller and also stored in cloud storage which can be retrieved during further health check-up or treatment.

3.2 Advantages of Digital Medical Assistant

a. Remote monitoring:

Diagnosing the illness and giving treatment can be done using Real-time remote monitoring via connected IoT devices and smart alerts which can save lives by diagnosing the illnesses, treat diseases and save lives in health related crisis.

b. Prevention:

Occurrences of diseases and acute states can be reduced by Smart sensors which analyze the health conditions, way of life decisions and the environment.

c. Reduction of costs:

IoT decreases expensive visits to specialists and medical clinic assertions and makes testing more moderate.

4 EXPERIMENTAL SETUP

The physical model of the proposed system has been developed based on the above requirements also and usage scenarios

from a user, an operational and an administrative perspective. The requirements specification also provides a detailed view of the system, its parameters and goals. It describes the target audience and its user interface, hardware and software requirements.

4.1 Hardware Components

The various sensors and components used in the prototype model are heart beat sensor, temperature sensor, respiratory sensor, SPO2 sensor, LCD display, Wi-Fi Module, RFID reader, GSM module, Aurdino Mega board.

4.2 Software Components

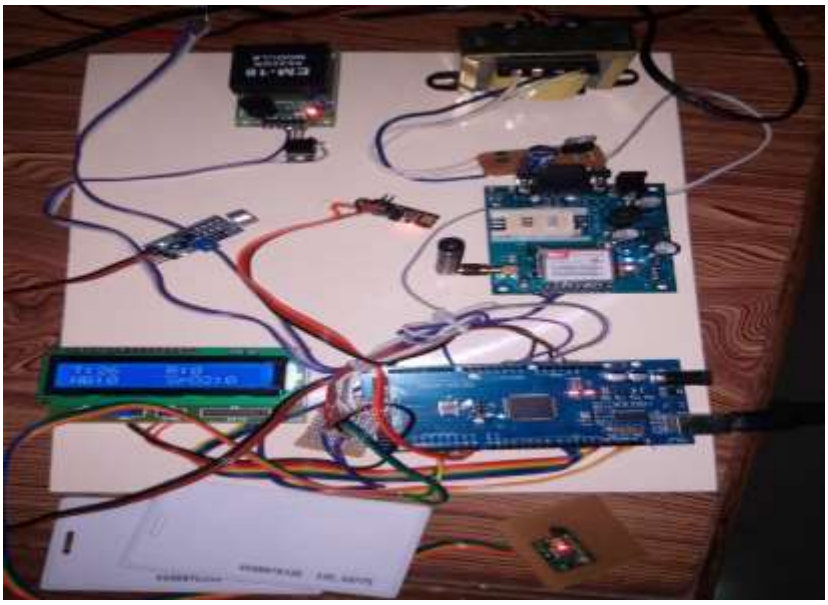
Software modules and the environment for development, operation and maintenance of the product are Aurdino IDE, Python IDE, and IoT platform. Think speak platform is used to send data to the cloud from any Internet-enabled device.

5. RESULTS AND DISCUSSIONS

The prototype of the system has been prepared as per the specifications mentioned in the previous section. Through the user interface, details of the patient are registered at the KIOSK and stored in Cloud Storage.

5.1 Prototype Design

Prototype model of the system is shown in Figure 3 which demonstrates the interconnection of components mentioned



in the previous section.

Fig.3: Prototype Model of the Digital Medical Assistant

5.2System Output

Fig. 4, 5, 6, and 7indicate the output received from the system during the health check-up of a patient of age 21, using the prototype model. The temperature, Respiration, Heart Beat Rate and SPO_2 levels are shown in the graph.

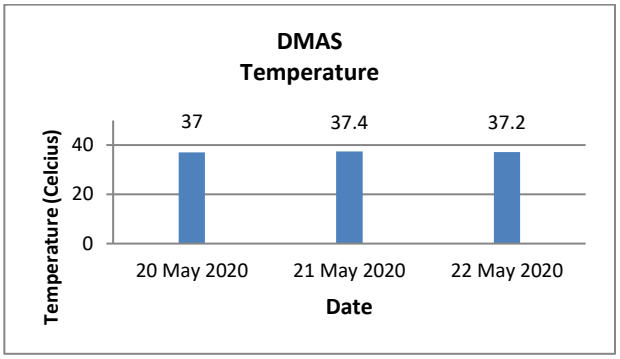


Fig. 4: Temperature

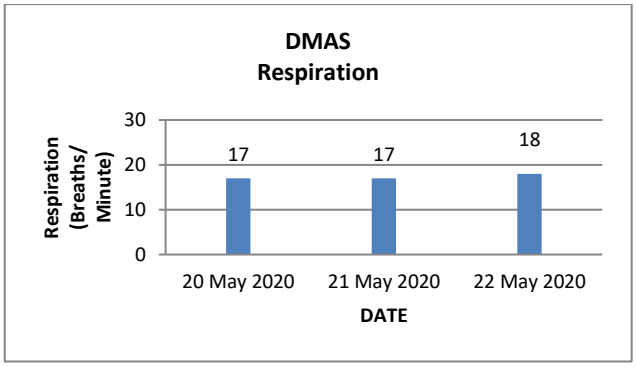


Fig. 5: Respiration

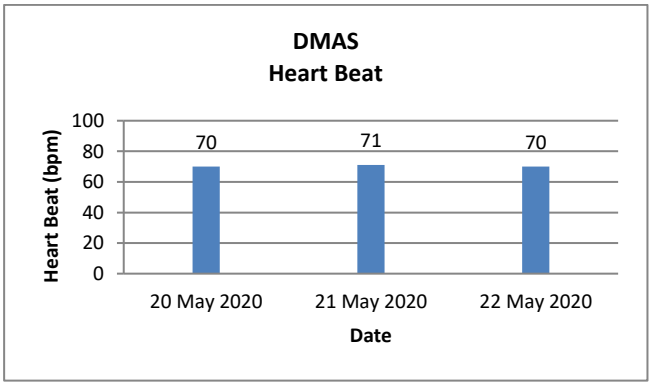


Fig. 6: Heart beat

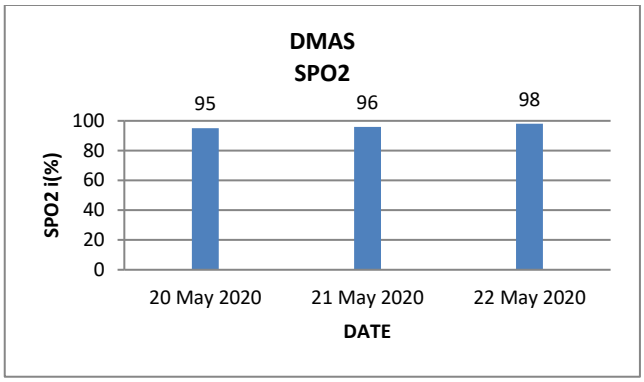


Fig. 7: SpO2

Anyone in need of a health check-up can make use of the facility and do the preliminary examination through the system without any human intervention. This system will provide a better solution to perform health check-up for a huge number of people especially during this COVID-19 pandemic situation and can prevent fatality rate by performing the preliminary examination at the early stage of development of the disease. As human intervention is very much less when compared to the other existing systems, the fatality rate of the health workers and physicians will also be reduced.

5.3 Discussions

Existing systems for preliminary examination of patents are done at the hospitals and health care centers at educational institutions, Corporate offices, etc. These systems involve human intervention in the process and is vulnerable to the spread of contagious disease to the health workers.

Voice assistants [3][17] for healthcare require the patients to communicate their ailments through voice to the systems for further consultation and recommendations. These systems depend on the perception of the patient on their understanding about the symptoms and are less reliable when the patients are ambiguous about their health conditions. Children of less than 10 years and elderly people of more than 60 years may not be able to correctly narrate their ailments accurately. Hence the examination by some automated system would help in measuring the basic parameters which can help in preliminary diagnosis and further recommendations for treatment.

The Proposed system supports preliminary examination of patients at a large number in a shorter period of time. Placing

these KIOSK at schools, colleges, corporate offices, malls, etc., will help the people with symptoms to check their health condition immediately and enable for further treatment quickly.

Table 1 : Comparison with Existing Systems

	Proposed System (DMAS KIOSK)	Voice Based Medical Assistant	Reaching to hospital directly
Feasibility	5	5	2-3
Accuracy	4.5	3	5
Time Effective	5	5	2
Help to reduce fatality	4.5	3	3
Risk to Health workers	nil	nil	4
Spread of disease	0.5	nil	4.5
Manpower Requirement	Less	Medium	Very High
Suitable for high dense population zones (School, Colleges, Corporate offices)	High	medium	Low
Suitable for remote villages	High	Medium	Medium

Voice based systems rely on the narration given by the patients and the accuracy of diagnosis will deviate based on that. Direct reach to hospitals is the most predominant practice observed large in real time practice. This requires physical visit to the hospital and most of the people hesitate to do at the initial stage of the disease. This practice leads to huge fatality as the patients are approaching the hospitals only after developing the disease to 50-60% severity. Direct involvement of health workers is high in this approach and this adds risk to their health.

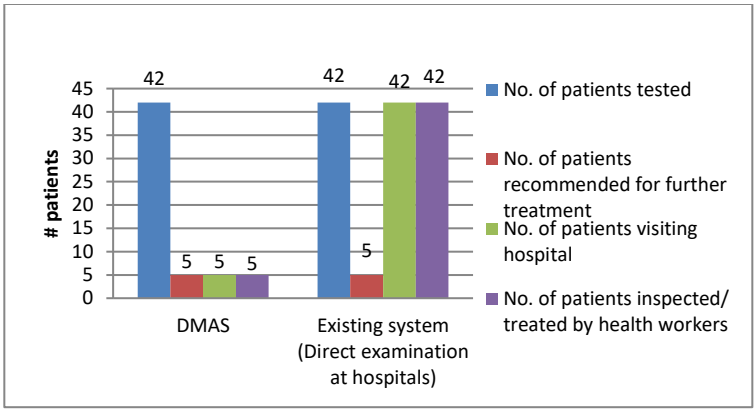


Fig. 8: Comparison with Existing System

With the testing done for 42 students having symptoms in an educational instituiton, 5 (11.9%) students were found to be having the health parameters in the abnormal range for two consecutive days and they were recommended to reach to hospital for further treatment. If the same testing is done with the existing systems, all 42 students must have been examined physically at the hospital. This will lead to huge requirement for health workers, equipments, transport, cost and time. Figure 8 and Table 1 clearly shows that the proposed system will help in improving the efficiency of the healthcare system by 88.1%, as only the patients in need of treatment are sent to hospital and that too at the initial stage of the infection itself.

6 CONCLUSIONS

The proposed system is expected to provide support to the Health Care Industry by means of reducing the overload to the health workers in doing the preliminary examinations for a huge number of people. This system can be placed in various public places like bus stands, railway stations, schools, colleges, Universities, shopping Malls and at some common places in villages. The persons with symptoms can be directed to do their preliminary check-up at these KIOSKs and further level of treatment can be recommended based on the parameter values collected. Patient is able to view the data directly from the LCD panel and understand their health condition. First aid medicines are prescribed immediately on seeing the parameters and this helps to prevent further deterioration of health before reaching the hospital. This automated system will aid in diagnosing the ailments at the initial stage itself since it is made available to public at their nearer places. Without any

intervention of humans, the system is smart enough to carry out all the functions on its own and its success depends upon how quickly it's adopted by the society.

7 FUTURE ENHANCEMENT

Automatic sanitization of the system after completing the process for every patient needs to be automated. Automated alert systems can be established to send alert to the relatives of the patient if the patient is found to be having alarming readings recorded. A recommendation system can be added to provide the details of the nearest hospitals for further treatment.

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