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Mobile healthcare using Internet of Things

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Abstract:

Internet of Medical Things is an assortment of medical units with applications that connect hook up to healthcare IT systems through online PC networks. Medical devices designed with WiFi let the device to device interaction is the basis of IoMT. Examples of IoMT include rural patient monitoring of individual with chronic or long term conditions monitoring patient medication orders and the positioning of patients accepted to hospitals;and patient's wearable mHealth devices, which can deliver data to care givers. IoT supporting clouds like Muzzley and AWS along with Message Queuing Telemetry Transport Protocol ensures quality of service. If any abnormal is being detected, a protocol will prudent the patient and the care giver instantaneously by sending an alert message to the care giver via the smart phone. Data security is accomplished by proper authentication and Device shadow will help to hold the persistent issue state during the intermittent connection. MQTT is preferred since it is simple to implement, light and bandwidth efficient.

Index Terms - IoT,Intel Galileo,Muzzley cloud ,MQTT,AWS

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I. INTRODUCTION

Health supervision plays a substantial role in the day-to-day life. The standard healthcare systems are mainly limited by hospitals.

Mobile medical care technology is vital [1], if the in-patient needs to be constantly monitored making use of their physiological information over an extended lengthy period.

An embedded device will hold a sensor as an indicator, digitize the information, process it later and transmit its value to Internet. Internet is a package based wherein each packet will afford different route to achieve the destination.Different size systems are utilized at one other ends hence TCP/IP language is needed to make the devices to talk with each other. Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to get in touch and communicate within social, environmental, and user contexts are called as Internet of Things (IoT)[2].Parts of IoT are:

- The thing itself (the device).
- The Local network, this will include a gateway which translates standard communication protocols to Internet Protocol.
- The Internet.
- Back-End services, enterprise data systems, or PCs and mobile devices.

II. MATERIALS AND METHODS:

Mobile health monitoring system includes two modules via hardware module and software module. Sensor nodes interfaced with Intel Galileo controller is the hardware module and a Muzzley APP combined with AWS services will come under the software module. Sensor nodes will sense periodically and measure the heart rate and blood glucose level of the human. After sensing, the device requires a controller and a communicator to transmit the value to the destination.

Intel Galileo is employed to acquire, accumulate, execute, broadcast vital sign data and alert the user if normal value exceeds. Shield compatibility, familiar IDE, RTC, Ethernet library compatibility, Linux on board support, I2C, SPI makes the Intel Galileo board more suitable for applications. The Table 1 gives the TCP/IP model with IoT protocols.

TCP /IP Model	IoT Protocols
Application	HTTPS,CoAP,MQTT,XMPP,AMQP,DDS
Transport	UDP,TCP
Internet	IPv6,6LoWPAN,RPL
Network access and physical	IEEE 802.15.4 WIFI(802.11 a/b/g/n) Ethernet(802.3) GSM,CDMA,LTE

Table 1: TCP/IP model with IoT protocols

Sensor Abstraction Layer:

Sensor Abstraction layer has sensing elements in it which includes the biomedical sensor. The physiological data is monitored and sends the information to the next layer called the processing layer.

Monitoring heart rate:

The Table 2 gives the average heart rate for all age groups.

Age	Newborn	7 years	14 years	Adult
Average heart rate (beats per minute)	140	85-90	80-85	70-80

Table 2: Average heart rate for all age groups

Monitoring blood glucose level:

Blood glucose level of various ranges are mentioned in the Table 3.The abnormal detection is intimated to the care givers.

Level	Range(mg/dl)
Abnormal level	215 to 380
Good level	158 to 100
Excellent Level	50 to 115

Table 3 : Blood Glucose Level

III. Internet and Protocol:

Application layer is the layer in which the programs and services understand each other. When one application programming in a framework can communicate with application layer programming it requires certain strategies which is taken care by the application layer. While characterizing application layer the following are to be considered. In the first place the message type must be stated clearly expressing what sort of message it holds, regardless of whether ask for request response or control message must be supported obviously. The communication rules are to be stated clearly. With much focus on the application layer, the comparison of various application layer protocols along with its parameters is given in Table 3.

Parameters	HTTP	CoAP	MQTT	DDS
Security	https	COAP-s	Low	High
Payload format	Flexible	Flexible	Flexible	Flexible
Compatibility	High	Low	Low	Low
Qos	Low	Medium	High	Very high
Performance	Low	High	High	Low
Model	Request response model	Request response model	Publish /subscribe	Request response model

Table 4 : Comparison Of Various Iot Protocols

Out of all the application layer protocols MQTT is given much preference for m-healthcare applications because it is a lightweight and bandwidth efficient protocol suitable for embedded devices. Message Queuing Telemetry Transport protocol is standardized by OASIS; TCP based asynchronous type of message supporting many to many communications. It is a publish/subscribe method wherein it publishes its data to a broker, then transmits the value to all the subscribers. The subscriber can either be durable or non-durable. The values can

be topic based, type based or content base. Port 8883 is used for MQTT over SSL. And port 1883 is preferred for MQTT. It can be used both in encrypted and unencrypted method of communication. Space decoupling, time decoupling and synchronization decoupling makes the MQTT protocol efficient for m-healthcare applications. The Table 4 gives the message types of MQTT.

MESSAGE TYPE	DESCRIPTION
CONNECT	Client request to connect to Server for connection
CONNACK	Connection Acknowledgement sent to the client
PUBLISH	Message which represents a separate publish
PUBACK	QoS 1 Response to a PUBLISH message
PUBREC	First part of QoS 2 message flow
PUBREL	Second part of QoS 2 message flow
PUBCOMP	Last part of the QoS 2 message flow
SUBSCRIBE	Message used by clients to subscribe to specific topics
SUBACK	Acknowledgement for a SUBSCRIBE message
UNSUBSCRIBE	A message used by clients to unsubscribe from specific topics
UNSUBACK	Acknowledgement of an UNSUBSCRIBE message
PINGREQ	Heartbeat message
PINGRESP	Heartbeat message acknowledgement
DISCONNECT	Graceful disconnect message sent by clients before disconnecting.

Table 4 : Message Types Of MQTT

The reliability of the message can be guaranteed with the Quality of Service options available in MQTT. With the QoS ability the user can guarantee the message delivery. Table 5 indicates the various QoS levels of MQTT.

QOS LEVEL	DESCRIPTION
0	At most once delivery
1	At least once delivery: Duplicate messages will occur
2	Exactly once delivery: The message is neither lost nor duplication is acceptable

Cloud computing is wherein the offload and on load processing tasks or storage from embedded system can take place for monitoring the data by which the analysis can be carried out. It not only support a standard way to speak with the devices ,but also learns from the user's interaction letting them to control all their devices from a common application, and on gathering usage data, it can predict user's actions and even produce different devices work together. Muzzley is the cloud which supports the IoT that comprises of connected devices, mobile apps, and cloud based services [3].

Units may be incorporated with Muzzley through the unit cloud or the unit itself. AWS on the other hand is simple to use variable, affordable, reliable, and scalable and performance and secure.

IV. PROPOSED SYSTEM

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The various sensors to monitor the human body like blood glucose sensor, Heart rate sensor are taken and the sensed value is fed into the Intel Galileo. The Intel Galileo device is registered in Muzzley and AWS cloud and various analyses is performed on it. The Muzzley and AWS, both support MQTT protocol. Figure 1 gives the overall picture of the proposed system.

Muzzley is the single purpose of entry for all associated gadgets, enabling its clients to manage, control, collaborate and even build up relations between gadgets. Muzzley cloud is a part of IoT wherein it is comprised of associated gadgets, portable applications and cloud based administration. Muzzley cloud has the ability to predict the user's action by learning from the interaction of the user with their own devices. Both Cloud to Cloud and Cloud to Device integration is possible in Muzzley cloud. The profile, channel, component and property

of the system are to be mentioned clearly while integrating. Apart from this, the integration type, HTTP URL, Interface UUID, email access list and Auth should be stated as the generic information about the integration.

A common connectivity framework is essential when the data is transmitted over muzzley cloud via which it is connected to the mobile APP. The Device is registered in AWS and via the device gateway it is transmitted to the end user. The rules engine transform messages based on rules to AWS services. The device shadow maintains the persistent thing state during intermittent connection. The various end users in AWS are AWS services, Amazon Dynamo DB, Amazon Kinesis etc. The MQTT over TLS is established in AWS services where a set of client libraries are present to connect, authenticate and exchange messages. MQTT is bandwidth efficient and lightweight protocol and hence it is preferred than the other protocols [4].

TABLE 5: QOS LEVELS OF MQTT

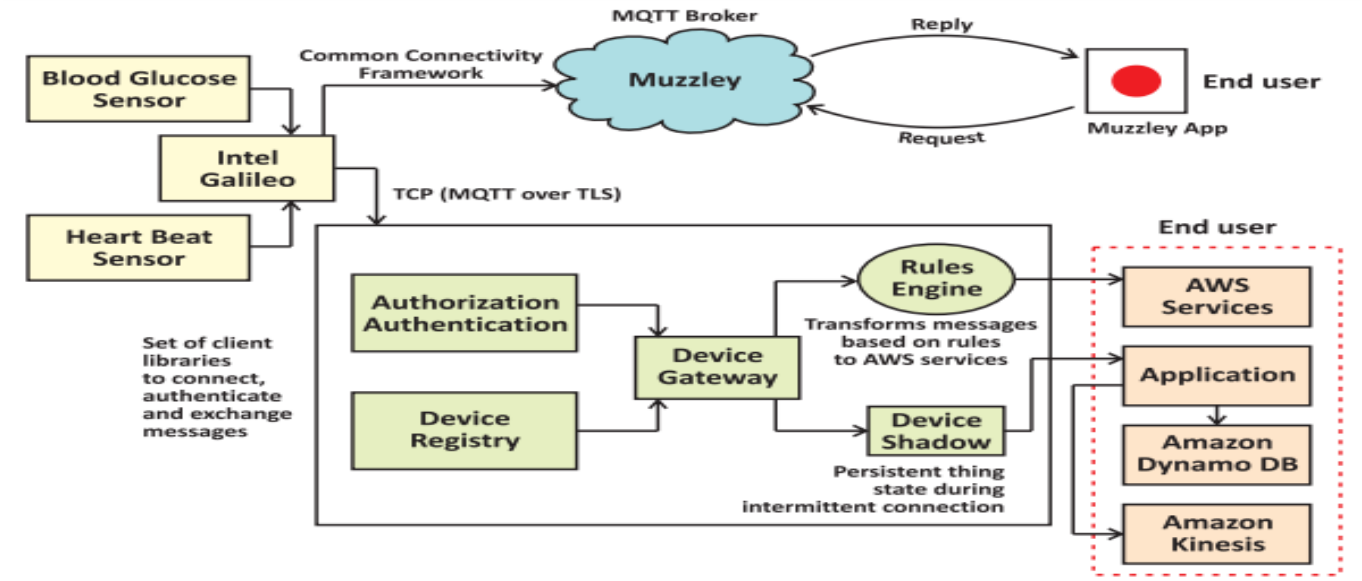

FIG 1: BLOCK DIAGRAM OF THE PROPOSED SYSTEM

V. CONCLUSION

Wireless M-healthcare system is comprised of mobile device along with sensors that communicates the users with the various physiological data to the care givers in case of urgent situation. The proposed system is time efficient and can help numerous patients from emergency. The instant data from the device can sort out various other complaints and can provide analysis to the data helping to predict the upcoming issues related to the patients thereby alerting the user from other complaints.

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