Design and Implementation of IOT Gateway for Developing Smart Swimming Pool

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Abstract

In this recent digital technology, connectivity act as a vital role and evolved as the trending feature within few years. All the major domain such as Internet of Things, VLSI has connectivity as key factor. Because of the changes made to the classical architecture, all the digital and analog components are connected to IOT. So, it is mandatory to make a common platform where all the devices and components with different standards of connectivity can be brought under a common platform and connected to IOT. This gives more flexibility for the system designing. We present the design and implementation of a smart swimming pool using IOT which allows technical and syntactic interoperability using standard protocols. It is effectively used to measure and control the respective pool parameters such as pool temperature, shed humidity, pool water level and to monitor pool security we also add smoke sensor

Key words: Iot, interoperability.

I. INTRODUCTION

A. Smart Environment

Smart environments are the secondary result of pervasive computing. It improves the availability of cheap computing power and also makes human interaction with the system as a pleasant experience. In such cases, physical environments get embedded with smart devices. Those smart devices include tags, sensors and controllers. They range from nano to micro to macro in size.We people develop a smart environment for devices. However, we are accompanied by smart devices like cellular phones, surface

Mounteddevices and embedded devices.Building a smart environment appertain few technologies like wireless communication, software architecture, middleware, sensor design, calibration, temperature, pressure sensors, parallel processing and accelerometers.

One of the significant developments of mankind is the Internet. IoT (Internet of Things) constitute the next evolution of the Internet. IoT has the capability of assembling, analyzing and sharing data among the Internet and a range of device and sensors.

This project deals about designing a smart swimming pool. It uses Raspberry Pi and Node MCU for the major communication. In order to get the sensed values, the sensors are calibrated and interfaced with Raspberry Pi and those values are in turn interfaced with NodeMCU to have user end control.This design proposes a new configurable smart IoT gateway with few pros. Those advantages are as follows.The gateway has pluggable architecture and modules with different communication protocols can be customized It has unified external interfaces and fit for flexible software development. It has flexible protocol to translate different sensor data into a uniform format. Compared with similar research, the gateway has better scalability, flexibility and lower cost.

B. IoT Gateway

IoT Gateway, as a hardware device or a virtual software code, acts as a communication bridge between IoT Sensor Network and Cloud Server. **IoT gateway device** has a layered architecture. Following are some of the important software and hardware layers to get better understanding regarding the **IoT Gateway Development** process:

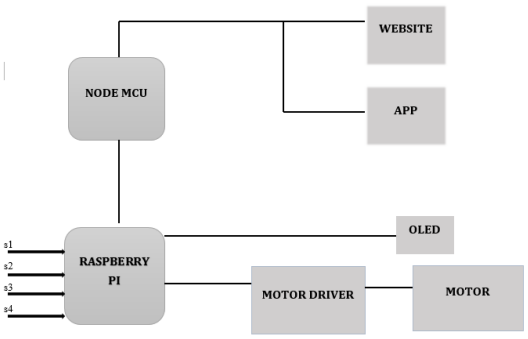
- Hardware Platform: This defines the processing power & memory specifications of the IoT Gateway. This is the gateway powerhouse and a hardware platform is selected based on the complexity of IoT application(s) that need to be deployed
- Operating System: The decision of opting for a particular OS depends on the legacy systems. It is a best practice to continue to use the OS compatible with the existing systems in order to save costs and hassle-free integration
- Analytics Engine: This layer ensures raw data is converted to actionable insights.

- Integrated Application development platform and Device Drivers: This layer supports development and/or addition of new devices, applications or systems to the IoT network. The main challenge on creating an IoT gateway is the lack of standards, being that each sensor node can communicate with a different protocol that is not compatible for others.

II. RELATED WORK

IoT gateways are made to connect the client to the network that allows easy data conversion. It is done between protocols that are used for short distance communication. To create a smart environment it is necessary to build a gateway such that it must support all the important entities such as sensor nodes, aggregation nodes, several standard protocols. One problem facing with gateways is that it cannot be used for a common application because several it is not compatible for several protocols in a same system. From Andre Gloria's smart environment paper we can infer the using of gateways for a specific application like pool monitoring. So with modifications we extend the idea of monitoring the pool along with controlling mechanism and instead of arduino, for better and reliable connectivity we use NodeMCU as aggregation node.Nevertheless, all have the same key requirements: low-cost hardware, easy implementation and extensibility and an application layer support.

III. SYSTEM ARCHITECTURE



VI. HARDWARE SPECIFICATIONS

A. Temperature sensor

LM35 is the temperature sensor which is used here. This indicates the temperature of the swimming pool and thereby identifies the changes that takes place. The desired temperature of the water can also be set after knowing the actual temperature only. Hence the indication of the water temperature is required.

B. Humidity sensor

Humidity is the amount of water present in the surrounding air. This senses the humidity changes of the water. This depends the various parameters for its measurement. It measures both moisture and air temperature.

C. Water level sensor

The necessity of knowing the water level is more important. To maintain the amount this sensor is required. The indication of decrease or increase in the level of water is shown and corrected accordingly.

D. Smoke sensor

This is a device which typically indicates the fire and senses smoke. Though they are expensive, the save thousands of live. Smoke is detected either optically or by physical process. These are used for the early warning of the fire.

E. Sensor node

Sensor node is also called as mote in North America and it has the ability of performing few processes, gathering sensory information and to communicate with other connected nodes. This is used to measure the changes in the physical condition of the environment. RASPBERRY PI with quad-core ARM Cortex-A53 is a small independent computer that runs on the various distribution of Linux operaing system and can be programmed as per the requirement. It is flexible and extensively used. A large working memory is present and has a muti operating processor which supports series of instructions. Depending on the needs it is possible to expand the Raspberry Pi with WiFi and Bluetooth adapters and also with several electronic components. These can be run in sever mode**.**

F. Aggregation node

Aggregation node is a point which has the collections of data. Node MCU is used as a aggregation node. Basically, it is 4Mbytes of ROM development board which is smaller in size. As they have a large memory it can store more code. These are smaller size development board. They provide a integrated support for WiFi network and consumes less energy. It has 11 GPIO pins and one analog to digital converter pin. It is a standalone board. These board are developed using lua language. Lua is a lightweight, multi-paradigm programming language. This used used as cross platform. It is fast, small, portable, and embeddable. These cornerstone of the language is well-suits in many facets of the software. These are class-less, prototype-oriented or even instance-based programming language. The language feature named delegation supports for prototype-based programming.

G. Software specifications

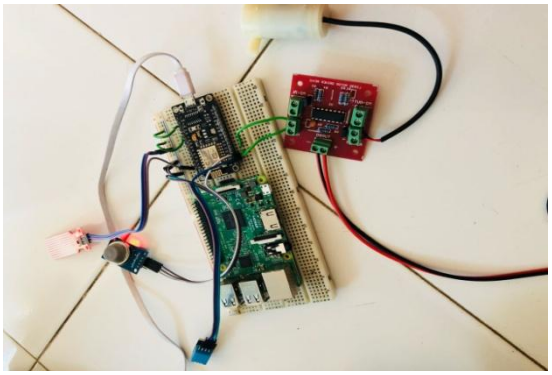
To develop smart environment like smart swimming pool we code the program using arduino software for hosting website that contains the calibrated values of sensors impregnated in the pool. Arduino software provides integrated development environment using specific programming language. It can be programmed using c,c++,Java scripts. To develop mobile we are using Android studio and designed using a code intended(c language) to deploy the wifi connectivity and to display necessary sensor values and has an option to change the pool parameters according to user specification.

H. Protocols used

Message Queue Telemetry Transport (MQTT), is an open, lightweight publish/subscribe messaging protocol that was developed specifically for small, constrained devices over wireless networks. MQTT brings a simplicity and scalability not found in traditional Internet or industrial protocols. The speed and efficiency of the protocol make it a popular choice for applications ranging from measurement and detection to supervisory control.In telecommunication and data transmission, serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. This is in contrast to parallel communication, where several bits are sent as a whole, on a link with several parallel channels. Serial communication is used for all long-haul communication and most computer networks, where the cost of cable and synchronization difficulties make parallel communication impractical.

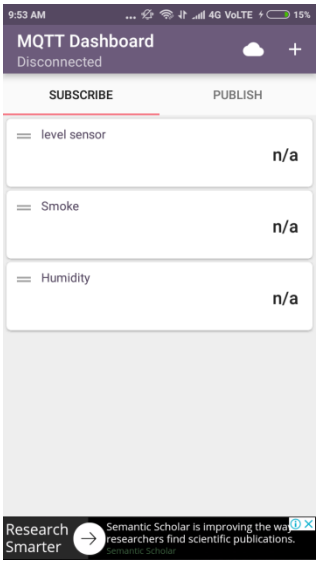
V. RESULT AND DISCUSSIONS

As discussed earlier an application and a website for real monitoring and controlling is developed on raspberry pi and Node Mcu. This website is build using adafruit and has easy user interface. This model is more adaptable and has high interoperability**.**



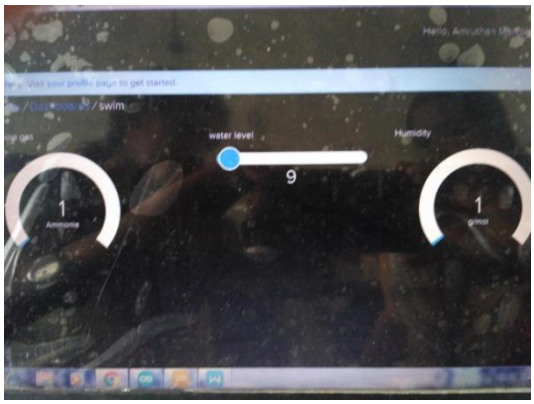
Hardware setup

This figure depicts the interface between the user and the swimming pool. Sensors are connected to the swimming pool to read the values. Motor driver circuit is used for controlling the level of water**.**



Application

As a part of the output we have developed a website using adafruit and the values from the pool are displayed and can be controlled through the website itself.



Website

VI. CONCLUSION

We have given a clear approach for developing smart swimming pool along with controlling mechanism using Raspberry Pi and NodeMCU which is cost wise more reliable and has high performance with good interoperability when compared to other systems.

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