STUDY OF ENVIRONMENTAL PARAMETERS BY IMPLEMENTING AN IOT NODE USING ARM CORTEX M3

[1]Prof. Dipali K. Shende [2]Prof. Vaishali S.Baste [3]Prof. D. N. Duche
Assistant Professor
Department of E & TC
SIT, Lonavala , India

***Abstract*— The IoT concept enables creation of the smart environments connecting with the citizens and shaping the cities around the world by offering a range of smart services with aim to increase the quality of life in the cities. Relating the environments with people requires an interface offering a amusing user experience able to involve and present the relevant information that fulfills the purpose of the service. The main goal is to raise community awareness of the importance of the environmental issues, in particular the air quality and effect on the human health of the air pollution. This task requires innovative methodologies and several approaches in attracting large participation and involvement in the activities related to these concerns. It is therefore important to present solutions that will be innovative, engaging and at the same time educational.**

The implementation of IoT concept is fulfilled by using ARM CORTEX which will enable faster computations of the data collected from the virtual cloud space using ADAFruit Server. This allows instructions and data accesses to take place at the same time, and as a result of this, the performance of the processor increases because data accesses do not affect the instruction pipeline. Thus The ARM subsystem will support IoT market growth by reducing development risk and enabling companies to quickly create products. Companies expected to license the subsystem include analog sensor makers and companies looking to add IoT connectivity to existing designs.

Keywords—Environmental Issues, ARM Coretx, ADAFruit Server, IoT connectivity,etc.

I. INTRODUCTION

If all objects in that we use in our daily life were well equipped with identifiers and wireless connectivity, these objects could communicate with each other and can be managed by computers,mobiles,etc[1]. In a 1999 article for the RFID Journal Kevin Ashton wrote: “If we had computers that knew everything there was to know about things—using data they gathered without any help from us -- we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory. RFID and sensor technology enable computers to observe, identify and understand the world—without the limitations of human-entered data.” Early trials and deployments of Internet of Things networks began with connecting and implementing industrial equipments with smart connectivity. Today , the vision of IoT has expanded to connect everything from commercial equipments to everyday objects[2]. The types of items range from IC engines to automobiles to energy meters. It can also include living organisms such as plants, farm animals and people. For example, the Cow Tracking Project in Essex uses data collected from radio positioning tags to monitor cows for illness and track behavior in the herd. Wearable computing and digital health devices, such as Nike+ Fuel band and Fitbit, are examples of how people are connecting in the Internet of Things landscape. Cisco has expanded the definition of IoT to the Internet of Everything (IoE), which includes people, places, objects and things. Basically anything you can attach a sensor and connectivity to can participate in the new connected ecosystems. The physical objects that are being connected will possess one or more sensors. Each sensor will monitor a specific condition such as location, vibration, motion and temperature[3]. In IoT, these sensors will connect to each other and to systems that can understand or present information from the sensor’s data feeds. These sensors will provide new information to a company’s systems and to people. This paper is based on one such implementation wherein different environmental parameters will be studied and monitored and hence several conclusions can be drawn which will facilitate better living conditions in a particular area.[4] The STM32F103xx medium-density performance line family incorporates the high-performance ARM Cortex-M3 32-bit RISC core operating at a 72 MHz frequency, high-speed embedded memories (Flash memory up to 128 Kbytes and SRAM up to 20 Kbytes), and an extensive range of enhanced I/Os and peripherals connected to two APB buses. All devices offer two 12-bit ADCs, three general purpose 16-bit timers plus one PWM timer, as well as standard and advanced communication interfaces: up to two I2Cs and SPIs, three USARTs, an USB and a CAN[5].

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network [6]. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers .The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

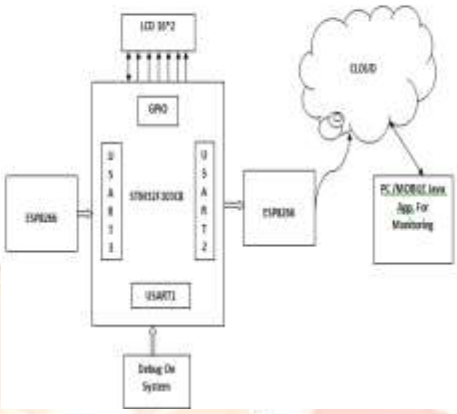


Fig 1 :- Master node interacting with Cloud

II. SYSTEM ARCHITECTURE

The system would have the architecture as below which consist of a Local LAN which send data to the master node where the data is processed and then transferred to the cloud . The data then can be accessed on individual mobile handsets by using JAVA applications mainly for Monitoring video output etc.

The fig. 1 shows the architecture of overall system. The total work is distributed between hardware and software part in this project. A balance between the flexibility of software programming and hardware efficiency and application specific nature is clearly demonstrated in this paper.

HARDWARE DESIGN

Development starts with ARM Cortex connected to a WIFI module (ESP8266) which would be the master node from where data is sent to the cloud. The master node receives raw data from other two sub nodes which are also developed using ESP8266 WIFI Module interfaces with ARDUINO Controller ATMEGA328P.This would constitute the Local LAN within the system. Information of what is hopping currently on the local LAN can be visualized using STM32F103C8 ARM CORTEX board interfaced with 16*2 LCD. The data shall be processed here and then sent to the cloud.

SOFTWARE DESIGN

C,C++ codes are developed to interact with the WIFI modules and ARDUINO Controllers. A JAVA application is developed on a mobile handset for synthesis, analysis and monitoring the data received from the cloud. MQTT protocol laid on TCP layer is made to interact with the WIFI module to send data over the cloud

fig 2 :- A sub node

III. SYSTEM MODEL

Fig 1 represents a master node. Master Node is the only device which is connected to the cloud directly and it translates the user cloud requests into internal communication protocols such as RF/IF. The IOT master node consists of a receiver module (ESP8266). This paper deals with the development of an android application using which the user can simply scan the data received from the cloud.
The master node consists of two ESP8266 WiFi chips and ARM board. One WIFI module is used to interact with the Local Area Network created by the sub nodes and the other WIFI chip is used to interact with the AdaFruit server which acts as a cloud.

A. *Master Node Realization*

Master node is the main center for accessing the internet .Hence it facilitates in building a network which is equipped with data storage elements which are not only responsible for data collection but also for data processing.

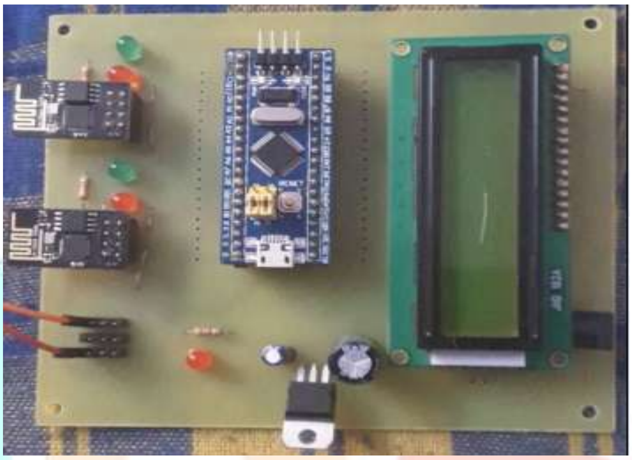
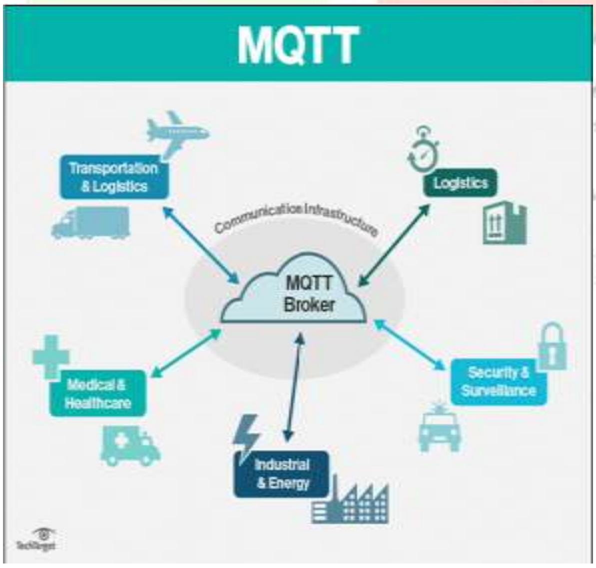


Fig 3 :- Master node

The WIFI chip connected at the end of the master node is responsible for:-

1) Data Storage on server
2) Data collection from server.



.

Fig 5:- MQTT extensions

Sub Node Realization

Fig 2 represents a sub node .Each sub node consists of an ESP8266 WIFI module connected to an ARDUINO Controller which has inbuilt UART(Universal Asynchronous Receiver/Transmitter) and ADC(Analog to Digital converter).These ARDUINIO controllers sense data from the different sensors and give their information the to the WIFI chips. This in turn is then given to the base node or the Master node.

The WIFI Module connected to the sub nodes has basically two functions:-

1) *Collect data from Nodes*
2) *Give data to ESP8266 WIFI module.*

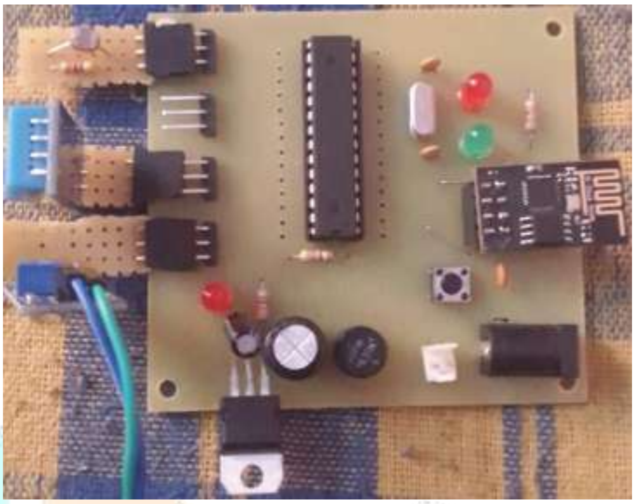


Fig 4:- Sub node

B. ***Cloud***

The AdaFruit server acts as a cloud which interacts with the WIFI chips through MQTT (formerly MQ Telemetry Transport) protocols. These protocols laid over TCP-IP are simple lightweight protocols for small sensors and mobile devices. An MQTT session is divided into four stages: connection, authentication, communication and termination. [8]The server client starts by creating a TCP/IP connection to the WIFI module by either using a standard port or a custom port defined by the broker's operators. When connecting, it is important to recognize that the server might continue an old session if provided with a re-used client identity. Once the connection is made, it is then possible to send data over to the cloud from the master node.[8]

IV. Conclusion And Future work

The JAVA application installed in the PC or Mobiles at the end user would get information from the server about the various environmental factors such as Temperature, Humidity, Air Quality, etc.The information's that are collected by the sensors could be used by the authorities to take necessary action such as emergency warning messages and evacuation of people to safe places. Further implementing pollution monitoring systems will help to assess how bad air pollution is from day to day and save the environment from further pollution. A future study to extend this approach to object of all shape and size can be explored. Also various other methods to include different environmental factors such as rain water measurement or Moisture study can be included in the study.

REFERENCES

[1] L. S.Atzori A.Tera and G. Morabito, "The Internet of Things:A survey, " Comput. Netw., Vol 54, no. 15, pp.2787-2805,2010

[2] I. Vilajosana, J. Llosa, B. Martinez, M. Domingo-Prieto, A. Angles, and X. Vilajosana, "Bootstrapping smart cities through a self-sustainable model based on big data flows," IEEE Commun. Mag., vol. 51, no. 6, pp. 128–134, Jun. 2013.

[3] J. M. Hernández-Muñoz, J. B. Vercher, L. Muñoz, J. A. Galache, M. Presser, L. A. Hernández Gómez, and J. Pettersson, "Smart Cities at the forefront of the future Internet," The Future Internet, Lect. Notes Comput. Sci., vol. 6656, pp. 447–462, 2011.

[4] C. E. A. Mulligan and M. Olsson, "Architectural implications of smart city business models: An evolutionary perspective," IEEE Commun. Mag., vol. 51, no. 6, pp. 80–85, Jun. 2013.

[5] N. Walravens and P. Ballon, "Platform business models for smart cities:From control and value to governance and public value," IEEE Commun.Mag., vol. 51, no. 6, pp. 72–79, Jun. 2013.

[6] X. Li, W. Shu, M. Li, H.-Y. Huang, P.-E. Luo, and M.-Y. Wu, "Performance evaluation of vehicle-based mobile sensor networks for traffic monitoring," IEEE Trans. Veh. Technol., vol. 58, no. 4, pp. 1647–1653,May 2009.

[7] S. Lee, D. Yoon, and A. Ghosh, "Intelligent parking lot application usingwireless sensor networks," in Proc. Int. Symp. Collab. Technol. Syst.,Chicago, May 19–23, 2008, pp. 48–57.

[8] 'What is MQTT'[ONLINE] internetofthingsagenda.techtarget.com/definition/MQTT-MQ-Telemetry-Transport.