SERVERS ROOM MONITORING SYSTEM USING IOT

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ABSTRACT- The IoT is going to change the computer network for next coming years it is becoming increase in the life of human and machines works. IoT devices corporate with energy consuming devices like switches, bulbs, TVs smart phone, etc. by connecting with each other as a machine to machine (M2M) to implement a specific job or a result. With the availabilities of open-source programming and the cheap consume devices will give more opportunities to normal people to use these services to change daily life, relations, geographic location, and communications. Many technologies devices and applications available for users to use and to develop the ideas, or create new services, from TINI OS, Raspberry PI, Arduino, and others, from these small kits with the studies plan and designed implementations, everyone can do his project which might become used in worldwide, or to improve your local area from your home to your workplace to society and your city. In this project, we will use a sensor to measure the humidity and temperature of a server room, and then send SMS and emails to administrator that the measurement reach to a dangerous level, which also give an option to the system to switch off all devices, connected in this room

INTRODUCTION

Server room is a very important place because of server location and data center, therefore the condition of this room must always protected from temperature and humidity, it has air-condition which is maintain air temperature, but if there is a damage in air-condition it will increase room temperature which also lead to increase humidity , also when main power source is off which could be diverted to UPS and battery becoming low or empty, therefore there is a need of additional tools to provide warning information regarding server room temperature, that is why we are going to IoT and sensors to provide the active solution to keep data and devices in this room safely.

GENERAL INTRODUCTION

The meaning of internet of thing (IoT) is the system of things using internet or private network to communicate and connect to each other and things means the devices that are not via the internet like smart phone and other smart devices has a unique identifier can transmit/receive data over network connection, even this is not a new thing, but the advance technology recently developed it. It has the capability to connect many devices if we install sensor this sensor can collect the data and send through internet or the network with low cost, also without connecting to internet like industrial application in a private network.

The data which could be collected and transfer through sensors are measured changes in vibration, impact, heat, light, energy, color, gases and temperature, this data will send usually to data repository in the cloud or local storage then forwarded to wherever user needs to send, these data was designed with a software built to ensure the data is converted to a useful information also the sensor is designed to measure the quality of data required to give value. Now a day still most of things not connected to internet like houses, roads, and everything around us will be connected to internet. We can say to understand the real internet is not only the wired network or signals through wireless it is a group of links where users share data it is the library of the new century and the store of data, photos, videos, notes, and calculators without looking in open books. All organizations must prepare for IoT to acknowledgment, that data could be collected from different locations in real time, the forecasting and Ideas of new data, and tools of analysis, which guide any organization to predict plans, and avoid cost of productions and risks in flexibilities ways. The internet is the network of network, which make the world in your hand, and in your devices. Organizations have two option either, starting with IoT, and fixed the budget for it to build active and modern technology, or losing the current speed of progressions of IoT, the organizations could offer more active services and production in a real time according to collected data by investing in high quality technology infrastructures and tools, inclusive practices which means the availability of environment that employees feels they are a part of changes which gives more chances of creations and changes of modern technology. When we said the network of network in that is means the home network, office network, and organizations

networks (small, medium, and large) all these networks are the basics of IoT. Network component of devices, services, connection links and users, devices can be servers, routers. Switches and access points, etc., While series is the software to give the response to users of the network, this software have the program, protocols of communications, and algorithm, while communication tools is the wired links, wireless links in the air around us which is the best for electromagnetic transmissions It is very necessary to differentiate between two types of devices in the network. First are end devices, which could be the target or sources it called hosts. It is the interface between users and networks, like computers, printers, phone (VOIP) and virtual reality devices, cameras, smart mobile phones, ATMs, and all types sensors which coming to the main parts of IoT. Second is intermediate network devices the devices that links end devices to provide connection, and process to ensure data reach from sources to target devices, it could connect more than two devices in one time like switches, routers, and firewalls it uses the destination address including algorithm to guide these data to its destinations. While processing or operating these devices can be, divide into:

- Generating and send data through the network
- Continues and save connection of information to know the root inside the network.
- Inform other devices when error happened or lose of connections.
- Redirected the data to suitable path when linked fail.
- Customize and redirect data according to quality of services (QoS).
- Authorizations and prevented data according to security network.

Intermediate devices determine the path of data but do not generate or change the data component. In transmissions data tools like twisted pairs and coaxial cables, fiber optics and wireless transmission, the massages will be coded in different ways matching with suitable transmissions, for example, copper wired connection the massages coded in electric signals where 1 presented positive, and 0 is negative, wherein fiber optics when there are light means positive or 1, and no light is negative 0, where wireless is using the electromagnetic signals waves, and those with different types of transmission media each network determined according to destinations, environment, the quantity of data with the speed of transmission and the cost of transmission and installations. The network can be divided into different types according to the size of the area to be covered, numbers of users linked to the network and services. Converged network is the first step to build network of smart data to support IoT, this closest will consider how the built applications with secure data through the network is secure and this must be ready for any changes and expanding flexibility. Before connecting any devices there is basic protocols used by all devices to implement success connection or conversation these protocols can be open source which can use its code and modified to generate new copy or owned by other companies or specific properties where code not available for modifying only with license owned by these companies. The specific duties of these protocols are to describe the type and infrastructure of massages, the ways of transferring information between the network devices and paths of sources and resources, when the transferring will happen, and the end of transmissions. These protocols implemented through hardware and software and each part of protocol is responsible of the part of preparing data to be send and received to other side. Main protocol is (TCIP\IP) any devices cannot connect to internet without it. TCP operates in transport layer to manage the conversation between for example web servers and web browsers it is also responsible for dividing the data into segments to be sent down to the internet layer. The special purpose devices do not have general processor to operate everything only they have a programmed controller to operate specific data collected by sensor then transferred to a general processor to generate. The main idea of IoT is use sensors in every device around us to be smart to reactive with users. Wireless connection protocols have different specifications in the figure below show some wireless protocols and where can be use. You can see these protocols can be many types of networks, which can used at home, and personal depends in the size of coverage area and some of them used for wireless and wired network together.

How to link devices not connect to internet?

We mentioned that some devices not using TCP/IP, which is IP-enabled how these devices connect to internet? Answer is, there are many techniques to link devices in low energy to network and send data to internet through low wireless connection in this case these devices will work without IP but they can send data through sensors to devices have IP and controller or gateway for example Bluetooth, ZigBee, NFC and 6LoWPAN. Not everything connected to internet is a computing device, as cars, TV, watch, etc., while computing devices have CPU, IN/OUTPUT and Memory. Devices or things have technique correspondence with servers and environment they

must have the tools for communications or network capable able to send data through trusted and secure network this communication will generate a huge data or extreme data, this data will change when needs to be used by users or to be generated automatically through devices without human interactions. By using sensors and RFID these sensors transfer vesical events from environment around us to electrical signal can procced by computing devices like humidity and temperature sensors, etc., The main types of sensors iRFID which using electromagnetic frequency to communicate and sending information between coded cards RFID tags and RFID. Most ranges of these cards are few meters while other hundreds of meters provided by battery and works as beacon send information continually because of low energy RFID is the useful tools to link these devices with network example car industries they use RFID in the body of cars for tracing in production and collection process. Controllers programmed to take standards to translate to data and signals then send to main device this controller collecting the data from sensors to be available in internet and users or to other devices to generate other action with other devices, to generate these data we need a data centers where controller send to router in to network then take data to where it should be taken. IoT can be achieved everywhere and any time when all technic of mobility, big data, and IPV6 to increase the IPs, around world. There is a lot of things can be developed or created by IoT starting from devices, sensors, controllers, processors, and programming language. To start any of these projects, first from ideas, then the commercial study in two ways, one the link with computer, and writing the program to control these devices when receiving any data from sensors to send to other devices, to do the required action, but this idea is costly than using Arduino or raspberry pi, Arduino is open source platform which can be programmed and controlling many devices at same time, to connect M2M machine to machine, machine to people M2P, and people to people P2P.

2.1 LITERATURE SURVEY

Devices monitoring, automation and controlling, employed in many applications, temperature, pressure, flow rate and other uses. One of examples a remote wireless monitoring system to get concrete temperature M. Kasim [1] proposed web-based temperature monitoring system, which continually monitoring the temperature condition of the room and data can be stored for analysis. B.Srinivas Raja and G.Srinivas Babu [2] proposed a system that can complete the remote access. Monitoring and maintenance operation of equipment through the network with web browser to operate devices in real time.

In 1099 Waheed at el, proposed to use a single-chip microcontroller to control the devices in real time, this idea used as backbone in many projects. In 2008, Wiietunge, at el, proposed a sensing and controlling through Bluetooth, which could control up to five devices. An application-programming interface (API) to develop a platform to enable application for a specific Bluetooth device, but Arduino UnoATmega328 microcontroller was the choice to develop as a low cost. Using alarming system for attending staff [3] in some situation where emergency happened when temperature and humidity sensor fail if the user is a way when these sensors raise an alarm should combines an alerting and data login system needed to avoid this case by sending the value of temperature by SMS and creating microcontroller database. The system design contained sensor of humidity and temperature DHT11, reading the module's output then extracted to suitable number in percentage and Celsius scale, and showing these in LCD. When Arduino send signal to DHT then DHT gives a response signal with data then Arduino will collect these data to two part the temperature part and humidity part.

Heat temperature and humidity should be monitored and controlled because of the factors they effect the operations of equipment's in server rooms in any organization, while administrator ensuring security against network attacks and failure in connectivity there is an environment threats on computer hardware [4]. While rapid temperature drop condones moist-air water on the devices which leading to higher cost in replace the equipment, also low humidity causes plastic part breakdown and electrostatic discharge which effects hardware quality and functionalities, server room should maintain its temperature between 18-27 ºC, and humidity between 38% and 48% also human factors should be monitored and controlled this is according to University of Texas. Online HTTP Information Server and SMS Alerts System for Mobile Weather Station through GSM Wireless Communication is also other purposes to use IoT to update values and information of rainfall reading [5]. They use in the weather station an Arduino open-source platform and compatible GSM shield for SMS and GPRS wireless communication, this GSM written to work with all types of GSM in local and international including SIM900 and SIM1008 shields, with using standard AT commands the program code can

configured to change with different service providers.

PROBLEM STATEMENT

In any design of project should fulfill the requirement to get the target, in some IoT implementations there is no complete or a universal project, because of the limit of space in devices of IoT, or network and security infrastructures also the limit of needs for a specific action, because of size of operations which needs a high controller unit like computers and servers or a high processor to process this type of operations, the low of cost, setting and programming of IoT is the most advantages to use these devices in many fields of industries and researches areas. But still the complicated of connectivity between devices and the long process of configuration is the most difficulties level for most of researchers, some sites like open-source application provide a ready setting or programming for some devices, but still the user needs to identify the exact needs of his project with full connectivity configuration and programming, with considering the compatibility between all these requirements. For example, in this project we found some similar research in the same field with deference of programming or devices used according to project target. Like sensors HTU 211D or Arduino UNO Raspberry Pi, these devices they have different numbers of pins could give limit of connection and power. Also, the programming of the integration between web application or database server is different in many projects, that is why it is a little bit complicated for new researcher, to choose the proper tools to achieve the target.

OBJECTIVE

When we look to all research, articles, and journals those focused in IoT, collecting data through devices in a specific time without user intervention the independence and updating information in real time is the main purposes of IoT. So, in this project we have used the sensor of HD110 to read the temperature and humidity in a server room with managing the different levels of technology from low-power communication, network routing and application- level access and IT system integration. This project will save server rooms from unexpected changes in rooms heating when power failure, also will keep parts in all devices in safe condition, as we know that all electronic chips becoming damage and short time life when they live in hot environment, with this project we can manage and monitoring the rooms status, SMS and email will received when the temperature or humidity becoming high, on that administrator can decide either switching off the hall servers or checking the reasons of heating. Other objective of this project is to use Arduino services capabilities with many other small projects in the same LAN to be monitored and controlled from the network administrator and system alert control, like for example fire alarm, attendance machines, counting entrance and reduce electricity used by switching lights and computers on a specific time.

SYSTEM DESIGN AND METHODOLOGY

Now a day all can communicate directly without having to meet in real time with using continuously connected internet. the IoT expand the benefit of internet with devices to keep these devices connected to each other without human interacting, in this project we will explain how sensors collecting data from server room, method and implementation. To protect server room to keep in safe condition as (Telecommunication infrastructure Standard for Data centers) [6] [7].

* Temperature 18-27º C (64-81 ºF) dry bulb temperature.

* Maximum relative humidity: 60%

* Maximum dew point: 15 º C (59 º F)

* The maximum temperature change rate: 5 º C (9 º F) per hour.

The temperature and humidity must be maintained according with health standards of the server room in the following formula that can provide a warning automatically:

- If: temp => 30 º the system will provide notification (1)
- If: humid => 60 º the system will provide notification (2)

Through DHT sensor reading and recording to Arduino then to database and web application. in this project we only use a private network which could be used also as a public network with internet.

METHOD:

Arduino pins and functions: -

- USB To PC: It is used to communicate Arduino via Universal Serial Bus to PC for programming/sending data to Arduino serially.

- 7V to 12V DC Input: For external supply, the voltage range of 7V to 12V DC is recommended. The 9V battery can be used to power your Arduino Uno board.
- Reset Button: It Resets the Arduino board if pressed. ICSP: Abbreviated as In Circuit Serial Programming which consists of MOSI, MISO, SCK, RESET, VCC, and GND. It is either used to program USB or Microcontroller (For UNO, ATmega 328P-PU). ICSP allows the user to program the microcontroller when it is in circuits, In Arduino UNO it allows to program ATmega328P-PU directly with AVR instructions without using Arduino IDE.

SDA: Serial Data, is the bidirectional data line that is used by I2C.

SCL: Serial Clock, It is used to indicate that data is ready on bidirectional data line that is used by I2C.

AREF : Analog Read Reference, It is mainly used for analog Reference() function calls, as default it is not required but to use it you have to add some voltage source between 0V to 5V in AREF Pin which will be considered as accurate reference voltage.

GND: Ground. SCK: Serial Clock, which is used by SPI (Serial Peripheral Interface). It is clock generated by „Master" which is used to clock the data to the „Slave".

MOSI: Master Out Slave In, the data is transmitted from Master to Slave. (Master -> Slave) MISO: Master in Slave Out, the data is transmitted to Master from Slave.

(Slave -> Master) SS: Slave Select, It is used to select the „Slave". Make high to SS pin to deactivate & make low to activate it.

INT1 & INT0: These are hardware interrupts; it calls the ISR (Interrupt Service Routine) when the pin change occurs. With Arduino UNO also with its platform open source and interactive software and hardware which receive analogue properties from environment with its RAM and ROM memories, input, output, interrupt, a clock that all connected in one chip.

The hardware like temperature, humidity sensor, and the ethernet shield.

The steps in this project are below: - [8]

1- Get Arduino board and USB cable
2- Download the Arduino Software (IDE).
3- Connect the board.
4- Install the drivers
5- Launch the Arduino application
6- Open the blink example
7- Select your board from Tools menu
8- Select your serial port
9- Upload the program

The data getting from Arduino and the time managed to process all operations through DHT 11 sensors to get the reading of temperature and humidity then these data will be stored in a database application that is why we must use WAMPSERVER or XAMPP phpMyAdmin then forwarded to web application, we will explain in detail the process of implementation in the next chapter. We must consider the goals of the project and the suitable application to get the results we are looking for, if we are looking in different research in the same field, we will find some difference in the implementations with use of tools either software or hardware. Understanding the work of DHT 11 is more interested to know about the component of this device, its determines the amountof Humidity present in the air using capacitive measurement with the electrical conductors and non-conduction polymer film exist between them this film collects the humidity of the air causes the changes in voltage levels between the two conducting plates there is substrate which absorbs water vapor and then release ions which is increases the conductivity between the electrodes, increase of humidity will decrease the resistance between electrodes then calculating the temperature by using thermistor has an NTC-Negative which make the resistance decreases with increase in temperature .

IMPLEMENTATION AND ANALYSIS

The implementation is starting from the connecting of the devices like for [9] example the USB cable to Arduino UNO to get power then install the driver also make sure communication ports are open in your OS, then install Arduino IDE to your computer from website, when it is downloaded open the LED Blink example sketch. Select your board from Tools menu Board "Arduino Uno" Arduino UNO then select your serial bord COM4 depends in your configuration, then write the program then upload then through the serial board screen you will see the results of your program. After getting the actual reading from sensor we need to keep or transfer these data in a database it could be saved in many places either internally or externally depends in your needs, in this project we will store the data in a

local server generated by MySQL phpMyAdmin xampp server which installed in a computer, to get data from Arduino sensor reading you need to create Arduino code to send data to xampp server before that you have to create a database with a name and table included field like for example Temperature Reading and Humidity Reading with date and time.

How to connect and sending data from Arduino to database?

By using functions and programming in Arduino codes you can do it and define your database with address of your network you are working on it , her in this type of projects you need to know that there is many ways as we said to create and design your implementation someone will divide the code to many files each will generate a specific action or process , her we use only two files one in Arduino UNO 3 this file included with the command to send data to MySQL database and make the connection, the other file which is in php programmed to display the data to a web page for displaying you can also uploaded it to cloud and manage your device from everywhere by internet connection, we need to tell you all of this work implemented without internet connection , but soon we need internet to receive emails and warning alert if the temperature or humidity becoming high, when you reaching to this area and getting data in database and showing in localhost through webpage all in real time you are in the final of project , her below you can see the php file which used to display the reading sensor on the webpage . also, with some techniques of development you can show a good design of webpage using many features of CSS and PHP or HTML or other design and programming tools to enhancement the looking of front page.

ANALYSIS

With the tools to implement IoT project, the elements which used to generate the results needs by the user are different as we said in the previous introduction, we will go through these elements below:

- Sensor specification: The specification of the sensor is very important when you are going to do like this project, because of the different types of sensors and different needs of the users and societies like for example the sensors used for agriculture and Irrigation System including many sensors used in this field from temperature and humidity and soil moisture with quality of collecting actual data.
- Control unit: Arduino and raspberry are an example of controlling and processing unit and must have the required specification depends in users use.
- Gateway hub or router: to make easy connection between IoT devices and sensors with the flexibility of transferring data.
- Server: the server is also very important to develop the database and the languages used in this purpose like PHP to support the extension phpMyAdmin which access the user into web.
- Web page: when your application ready it should introduce to users with friendly mood easy to read and sensor can operate data to user.
- Scalability: the flexibility to increase more services or nodes to project to grow the network from specific result to many results.

The connectivity and transferred of data were success between Arduino, DHT 11 and MySQL database using the tools we mentioned in this project, it was very interested work, when you get the result and reach to the main goal of it. To improve this project with more services we will go through new tool by using google spread sheet or logging data in google document because through the analysis of current implementation we only sending data to MySQL database also there are many ways logging data to spread sheet. When you make sure all devices connected, you need to create table in google spread sheet like the table you create in your database and give it a name then create an account in the additional website services to monitor and control it from anywhere. After creating the account your devices using device coder like for example ether shield or Arduino Uno, then you will be asked which sensor you are using if it is not in the list choose generic sensor [10]. After finishing the configuration on the website, in this configuration there are many technic processes you have follow the references of this paragraph to take more information.

In this project we use local hosting and local server database, to expanding this project, we will go through many services and devices, this is the requirements we need to know in current time. As we said any project built it depends in your needs. We will explain the future services that could be added, as we mentioned before the fire alarm, light switch off and on by sensing the movement to reduce electricity consumption. Plotting the data before displaying your codes to end user by dividing the codes to some steps of codes to be generated one by and checking the result. Then

following this procedure with all codes will make any project easy to implement with accurate design without mistakes or repeated codes, the database storing, and connectivity will make some trouble for the beginners to understand it. But when starting work in steps with checking each step it will work finally.

To monitoring the project on the internet we are going to use thing speak open-source application; this application will fetch the data from Arduino through channel template.

MySQL as a database management system:

MySQL is an open-source database management system, is developed and distributed by Oracle corporation, soon when this project expanded, we will use the relation between tables inside the database because each event or action we need to request from Arduino to do will contain a data these data for more arrangement and smoothly generate need to separate each event I separate table or query, and the open source of MySQL means everyone can modified as it use general public license. In this project we create only one table inside a database and the also the server of this data is MySQL server in the local computer below table showing the data structure of the database and table created in this project we can see the type of data, the length and other field most of them created by MySQL, it is help the user to analyze and design his database according to his needs, but with considering the rules and the language.

Table 4.1 Database Structure

Field	Min value	Max value	Min length	Max length	Emptie s or zeros	Null	Avg_value Or avg_lengt h	Std	Optimal Field type	
temphumi id.dht11.i d	NULL	NULL	0	0	0	0	0.0	0.0	CHAR(0) NULL	NOT
temphumi id.dht11. humidity	NULL	NULL	0	0	0	0	0.0	0.0	CHAR(0) NULL	NOT
temphumi id.dht11.t emperatu re	NULL	NULL	0	0	0	0	0.0	0.0	CHAR(0) NULL	NOT
temphumi id.dht11. Date	NULL	NULL	0	0	0	0	0.0	NULL	CHAR(0) NULL	NOT

In the below table we can see the results of sensor reading in MySQL database which reading in descending order from last sensor read.

ID	Humidity	Temperature	DATE
31	45	27	2020-09-18 21:24:28
30	45	27	2020-09-18 21:24:23
29	45	27	2020-09-18 21:24:18
28	45	27	2020-09-18 21:24:13
27	45	27	2020-09-18 21:24:08
26	45	27	2020-09-18 21:24:03
25	45	27	2020-09-18 21:23:58
24	45	27	2020-09-18 21:23:5

In real time the same data of the sensor reading will showed in webpage created by the user in a friendly screen, this webpage can be modified for many purposes. Depends on project expanding and user needs.

CONCLUSION

Whatever we did and discover in the world of technology there is more and more things not touched by hand, the things which make difference in our life, in this project what I learned by researches and implementations of programming or network connectivity tools is more important to me and field of computer science, but still you feel you are not covering this world of technology of all contents from ions to digits or signals waves and devices designed to do these jobs, when I started in this project I heard about Arduino and how this device is simple, cheap and workable to do whatever you need in IoT, the relations between devices and communication with each other smoothly with simple program, network connectivity and secure communication.

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