Smart Home Automation System using Internet of Thing (IoT)

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1. Introduction

The Internet of Things (IoT) is sometimes referred to as the internet of objects that describe by Dave Evans, is to change or will change everything including ourselves. The internet had apparently been one of the most essential and influential creations in all human history as it had done many simultaneous innovations in education, communications, businesses, sciences and humanity itself [1]. Lopez Research of Cisco added that IoT describes a system where the object in the physical world, and sensors within or attached these objects are connected to the Internet via wireless and wired Internet connections [2]. The IoT, can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver of anything or any other natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network [3]. These statements prove the fact that IoT is a term used for connection of worldly devices over the web that improves communication between human-to-machine and machine-to-machine relations.

Nowadays, society is fixated by the idea that they can control their house, cars, and electrical appliances, automatically via their computers and mobile devices, and this simplifies things of not doing those tasks themselves as everything is regulated automatically to the fixed algorithm provided by what society needs over the network. IoT has been developed extensively that there are now no walls between the interactions anymore that are limited to machine-to-machine only. It saves costs, time and providing no additional charge for a significant amount of cabling through walls or underground as everything is connected to the cloud-based system. Experts from Cisco IBSG have predicted that there will be around 50 billion connected devices to the internet in the year 2020 [1] as technology continues to grow.

To show this theory relatable, this project: Smart Home with Wireless Integrated Weather Monitoring System is an example, and it will provide the most straightforward term of how IoT works. Smart Home has been developed for quite some time as it allows for comfortability, entertainment and security to the users and the focus of this is to integrate ease of communication between the house and the humans living inside it, with interactions or none at all. This weather monitoring system is set to ensure full automation on home comfortability. This project will control the lights based on the lighting inside the house automatically; fans will be turned on automatically while there will be a water sprinkler on the roof to shower the hot roof panels from the sun rays to cool down the temperature of the house. All the devices can also be controlled manually if the user wants it. Lastly, this system also provides the essential monitoring for temperature, humidity, lux intensity, and weather.

Comfortability in houses is number one priority as it is where society goes to rest and spend their time with families. Usually, people will create those prospects by turning on the fan, dimming the lights but what if all the devices can be automated by a system while monitoring the surroundings variables? Smart Houses is a system that will prioritize the minimization of human interactions in the process, and this creates importance over anything now as technology grows transparently. Secondly, a lot of big projects nowadays used tons of cables and wasted a tremendous amount of money to overcome obstacles underground or through buildings. Here is where IoT could simplify the problem and saves cost if applied. Although there are a lot of IoT projects that are still being developed, most of them are not implemented mostly due to the little knowledge of technology reliability. There are several solutions, via connecting the controllers and sensors over the Wi-Fi, where the controller can activate the relays with the data given through the network. There are a lot of controllers and microcontrollers released throughout the years, and this gave developers to create possibilities that seem impossible decades ago; to create an inter-connection seamlessly between the devices, sensors and the control panels. Controllers such as Arduino with the Wi-Fi shields, Raspberry Pi type B with its integrated Wi-Fi module, Micro Intel Boards, and other microcontroller development kits. This project will use Arduino Uno with an Ethernet Shield as the controller to connect all the devices needed for the monitoring system and to control the hardware, lighting and the water sprinkler with it just to show a few applications. The Arduino Uno will be integrated with Android and an IoT Platform for monitoring and manual control through the network. The data received can transfer and stored between them through the cloud-based system on the web. This project will test the possibilities of accuracy and the reliability of data transferring time on a real-time basis to accommodate the faulty delay that will present with each data.

2. System Design

The Arduino board will be connected to Android, for that specific method with existing programming platforms available by the open source developers like Thinger.io™ and Windows 10 IoT Core™. Furthermore, the monitoring system must be able to monitor the temperature, humidity, and lighting and also able to make a quick prediction on weather from the given variables while collecting data. For this, the Data Bucket from Thinger.io™ will be used for the cloud data storage; archiving the data received by the Arduino from the sensors.

2.1 Hardware Implementation

Microcontroller

Arduino Uno is used as a microcontroller for this system. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which six can be used as PWM outputs), six analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Arduino Uno R3 uses Atmega328 as a processor which is smaller than any other processor.

The Arduino Ethernet Shield connects your Arduino to the internet with RJ45 cable. It has an operating voltage of 5V which is supplied by the Arduino board. A W550 Ethernet Controller with an internal 32K buffer which is a good and optimal controller. The W5500 provides a network (IP) stack capable of both TCP and UDP. It supports up to eight simultaneous socket connections. It can hold the connection speed up to 10/100 Mb and the Ethernet Shield establish a connection with the Arduino with the SPI port.

Sensors

Sensors that are used in this project are light intensity sensor, humidity sensor, and temperature sensor. Photo Resistor LDR sensor is a light-controlled variable resistor. As the light intensity increases, the resistance in the sensor decreases as this sensor exhibits photoconductivity as it is made from high resistance semiconductor. The DHT11 is a low-cost digital humidity sensor. It uses a capacitive humidity to measure the surrounding air and put out digital signal on the data pin as this sensor does not need any ADC connected. It is relatively simple to use but requires careful timing to grab data. The sensor can get new accurate data every 2-second time delay. This sensor also used low power, about 3V-5V.

2.2 Software Implementation

In this phase, the entire system and software are designed. The data structure design is all defined at this stage. A software development model is created. Analysis and design are very crucial in the whole development cycle. Any glitch in the design phase could be costly to solve in the later stage of the software development. Much care is taken during this stage. The logical system of the product is developed at this stage.

Figure 1 shows the overall home monitoring system. Arduino is used for collecting data from sensors and send it to the server in real time. The user can extract data from the server using home monitoring mobile application.

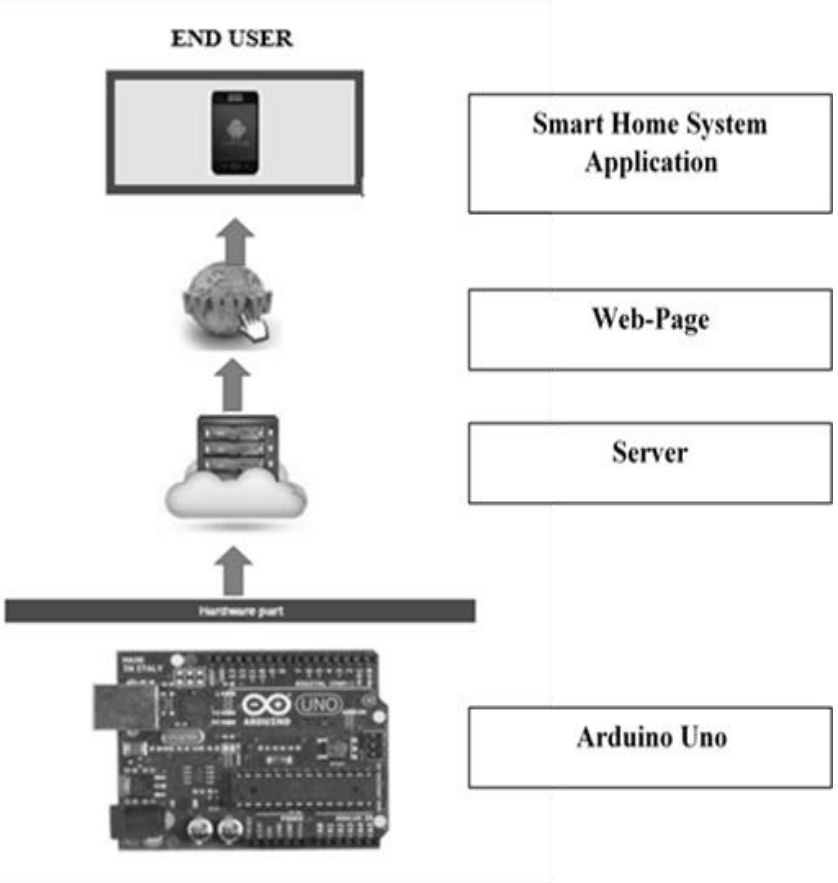

Fig. 1 - Overall monitoring system

3. Results

This section discusses the results of the entire system. This system is divided into two modules, one module is used to sense all sensor data by different interfacing sensor to the Arduino Uno board, and another module is used to send the data on the web. The web page is created where all sensor data is displayed with the control button. The control button is used to control the devices from a web page. The interfacing of all sensor to Arduino board is shown in Figure 2. WiFi module used to connect the Arduino Uno board and IoT platform. The data collected to from sensors were transferred to the cloud through WiFi module and display the data on the platform dashboard.

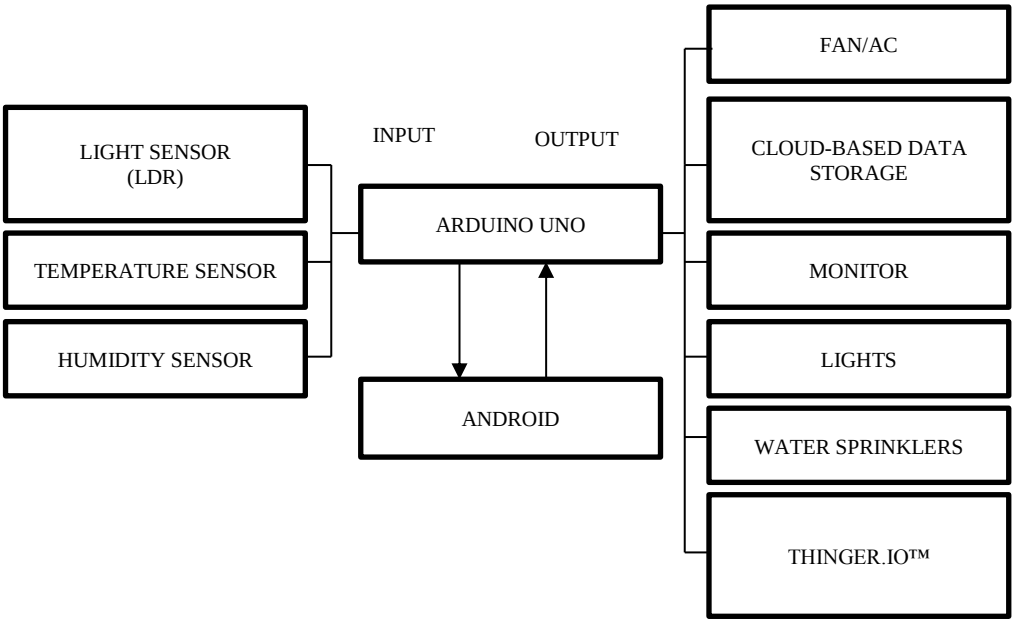

Fig. 2 - Block Diagram for Smart Home Monitoring System

Figure 3 shows temperature and humidity sensor reading display on LCD. As the temperature is the only solid parameter and the most appropriate to determine whether it is 'Sunny' or 'Raining' outside, the algorithm that will be used is to compare between them depending on the temperature read by the Arduino.

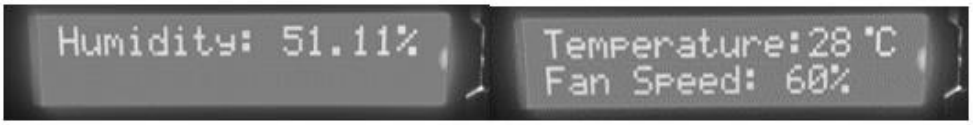

Fig. 3 - Temperature and humidity reading on LCD

A simple code as shown in Figure 4 was used, 'if' and 'else' to determine the weather. The next part is to integrate the Arduino board with the IoT Platform. Thinger.io™ is used to store the data collected from microcontroller. Figure 5 shows the dashboard of Thinger.io™ which contains the temperature and humidity data. Figure 6 shows the Pseudo code used for lighting brightness. The data is sent to Thinger.io™ for monitoring.

```
thing["dht11"] >> [](pson& out){              //sending data out to Thinger.io™ as
                                              //'dht11'
    out["humidity"] = DHT.humidity;           //sending humidity value
    out["celsius"] = DHT.temperature;         //sending temperature value
    out["CON"] = if (temp <= 27) {
              ("Raining"); }                  //sending text 'raining'
       else if (temp == 28) {
              ("Cloudy"); }                   //sending text 'cloudy'
       else {
              ("Sunny"); }                    //sending text 'sunny'
  };
```

Fig. 4 - Pseudo code to determine humidity

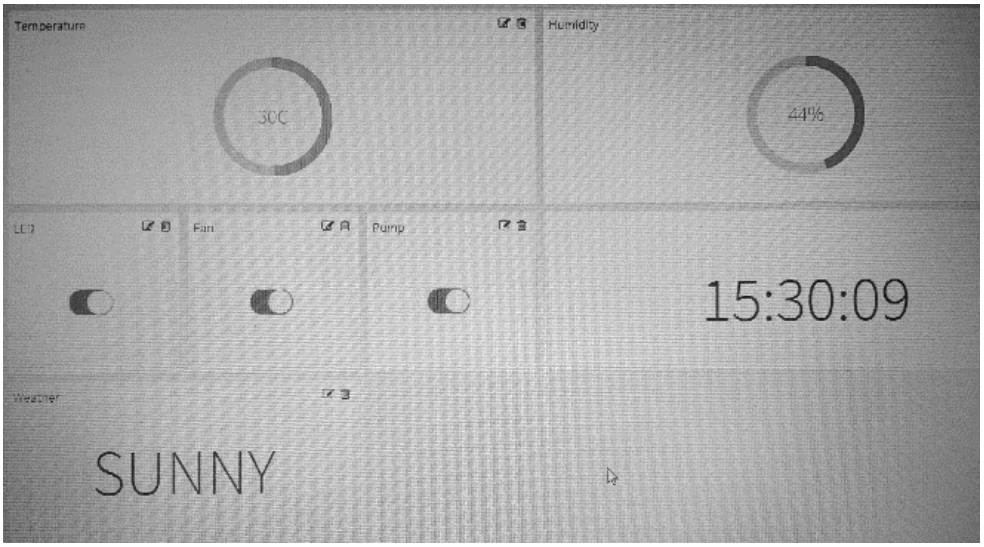

Fig. 5 - Data from Thinger.io™ dashboard

The value of Lux:

```
Lux=(2500/((analogRead*0.0048828125)-500))/10          //step is defined by 5/1024
```

Fig. 6 - Pseudo code for LED

The LEDs need to be dimmed when the light intensity is high; this means it needs to create a pull-down condition on the LDR to reverse the effect rather than have it light up when the lux intensity is high. The dimming result is shown in Figure 7.

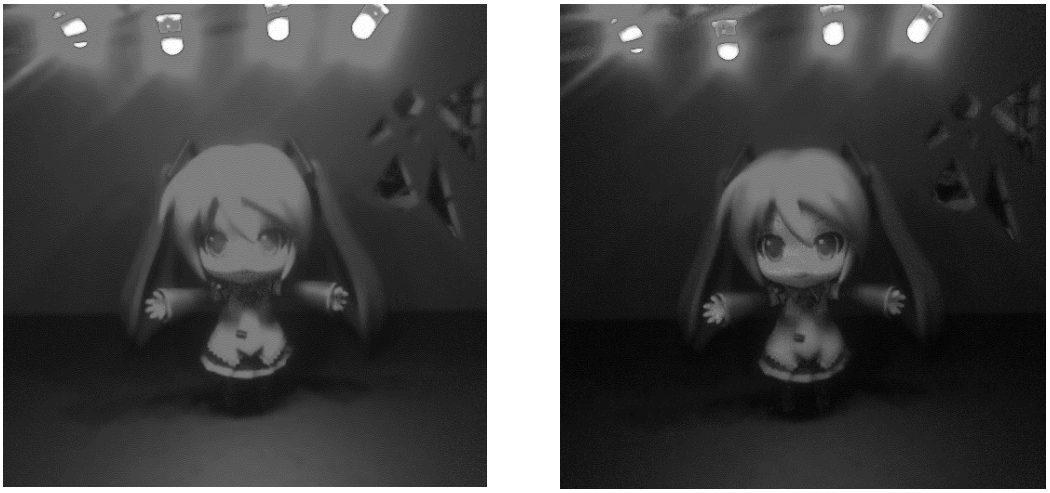

Fig. 7 - Dimming effect

Fan speed depends on the temperature, if the temperature is less than 26º fan will automatically off. And the speed is increased gradually as the temperature rose as tabulated in Table 1.

Table 1 - Fan speed

Temperature (˚C)	**Fan Speed**	**Remarks**
Less than 26	OFF	Pump Off
26	20%	-
27	40%	-
28	60%	-
29	80%	-
30	100%	-
More or equal to 31	100%	Pump On

4. Conclusions

The smart home monitoring system is successfully developed using IoT. This is called as smart home which can access from the remote location. Smart home monitoring system plays an important role. This system based on to monitoring & controls all the parameters with the use of different sensors. All sensors are selected depending upon the characteristics and specification required for the system to give an accurate result. This parameter sends to the user through the web browser. The system contains different sensors like humidity sensor, temperature, LDR sensor integrated to Arduino Uno is used to send the data on web page. The all sensor value is updated after every 5 seconds.

References

1. D. Evans, *The Internet of Things: How the Next Evolution of the Internet is Changing Everything*, 1st ed. Cisco Internet Business Solutions Group (IBSG), 2011, p. 11.
2. M. Rouse, "What is Internet of Things (IoT)? - Definition from WhatIs.com", *IoT Agenda*, 2016. [Online]. Available: http://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT. [Accessed: 24- Nov- 2016].
3. S. Indart and P. Wuttidittachotti, "Smart Farm Monitoring Using Raspberry Pi and Arduino," *IEEE 2015 International Conference*, p. 5, 2015.
4. M. Abdul Jamil and M. Ahmad, "A Pilot Study: Development of Home Automation System via Raspberry Pi," *201 2nd International Conference on Biomedical Engineering*, p. 4, 2015.
5. M. Ibrahim, "Internet of Things based Smart Environmental Monitoring using the Raspberry-Pi Computer," *2015 IEEE Conference*, p. 6, 2015.
6. J. B. Lopez and H. M. Villaruz, "Low-Cost Weather Monitoring System with Online Logging and Data Visualization," *8th IEEE International Conference Humanoid, Nanotechnology*, p. 6, 2015.
7. M. Asay, a. Myers, b. Proffitt, o. Thomas and D. Curry, "Xively Connect Things In The Internet Of Things - ReadWrite," *ReadWrite*, 2016. [Online]. Available: http://readwrite.com/2013/05/14/xively-actually-connects-things-in-the-internet-of-things/. [Accessed: 28- Nov- 2016].
8. B. Benchoff, "Raspberry Pi and Windows 10 IoT Core: A Huge Letdown", *Hackaday*, 2016. [Online]. Available: http://hackaday.com/2015/08/13/raspberry-pi-and-windows-10-iot-core-a-huge-letdown/. [Accessed: 29- Nov- 2016]