SMART HOME SYSTEM BASED ON WI-FI AND IOT

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ABSTRACT

Smart home systems are very important and promising area because of saving energy, money, time and providing security, safety and comfort. In addition smart home systems can help disabled people and elderly people with special needs. This paper presents integrated smart home system. The sensors are classified into three types internal (indoor), external (outdoor) and combined that can be used indoor and outdoor. Another classification based on the best location to locate the sensors has been made. Also, the priority in reading the sensors has been taken in our design. The system is designed to be scalable, flexible and low cost which depends on using Internet of Things (IoT) .The proposed system has the facility of monitoring the home environment and controlling the household appliances locally and remotely from anywhere in the world across the internet. DeviceBit and Blynk are used as platforms for monitoring, controlling and sending notifications and emails in real time. Experiments are conducted and the results showed that the proposed system is feasible.

Keywords

IoT, Smart Home, DeviceBit Platform, Embedded system, Blynk Platform, Ethernet Shield, Arduino Mega 2560, CC3000 WiFi Shield

I. INTRODUCTION

Home Automation System (HAS) based on IoT is growing around the world day by day, especially in the last few years as things become connected and interacted with each other through the Internet. Smart home systems are providing security and comfort to their owners. In addition these systems are energy efficient which represents one of the most important issues of concern to the world today. Some researchers have done design and implementation of smart homes based on different technology using different sensors. In [1] Internet of Things (IoT) based smart home system using 3G embedded system and Zigbee technologies were introduced. Variety of smart home systems has been constructed based on Bluetooth, internet and short message service (SMS). In [2] Bluetooth might be one of the best wireless systems. However, the main limitation in this system is the short range which makes it feasible for smart home indoor applications. In [3] home automation system based on IoT for monitoring and controlling different sensors were introduced based on the android smart phone and using internet service. Smart homes with different sensors were introduced in [4-9] to monitor and control different household appliances. In this paper smart home system is proposed based on Arduino Mega2560 as the main controller with the Ethernet Shield (W5100) and CC3000 Wi-Fi Shield with different indoor, outdoor and combined sensors. Different output devices are used for monitoring and controlling the smart home appliances. Smart home system has been adopted the IoT and the wireless technology (GSM) for monitoring the smart home environment [10-11]. Smart home system has been constructed based on Wi-Fi technology and Infrared wireless technology (IR), the home appliances are controlled by a smart phone or computer through the web page that will represented the user interface to handle home environment. The infrared receiver (IR-Receiver VS1838b) connected to the microcontroller and the remote control is given to older people, people with disabilities and people who cannot use the smartphones to help them control the appliances [12]. The paper is organized as follows. In Section II, the system design is presented showing and describing the main electronic

components and sensors that have been used in this paper. Also, this section describes the results and the discussions for the experiments that have been conducted. Finally, in section III we draw conclusions and discuss the direction of future work.

II. SYSTEM DESIGN

The system is designed based on Arduino Mega 2560 which is considered the mastermind of the proposed system. The proposed system will be connected to the internet in two ways, using the Ethernet Shield W5100 with Arduino, where home environment will be monitored and controlled through the use of the DeviceBit platform, which features two versions, ones running on the computer for management and monitoring while the other version will be an application used on mobile phones. The second method has been used to connect the proposed system to the internet though the CC3000 Wi-Fi Shield with Arduino, where the smart home environment will be managed and controlled by using Blynk platform. Different indoor, outdoor and combined sensors are used in the integrated smart home system; Table 1 represents classification of sensors used in the proposed smart home. The priority in reading the sensors has been taken in our design; the sensors reading according to their priorities will be as follows: (Flame Sensor, Gas Sensor, DHT11-Indoor, DHT11-Outdoor, LDR-Outdoor, LDR-Indoor, PIR-Outdoor, PIR-Indoor, RFID, Rain Drop Sensor and Pressure Sensor BMP180).

Table 1: Classification of sensors used in the proposed smart home system

Indoor	Outdoor	Indoor & Outdoor (combined)
……..	Pressure Sensor BMP180	……..
……..	Rain Drop Sensor	……..
……..	……..	Temperature and Humidity Sensor (DHT11)
……..	……..	PIR Sensor (HC-SR501)
……..	……..	Light Dependent Resistor (LDR)
MQ-2 Gas Sensor	……..	……..
Flame Sensor	……..	……..
……..	RFID	……..

2.1 Outdoor and Internal Weather Monitoring Systems

DHT11 temperature and humidity sensor is located indoor the house and outdoor, the data from this sensor can be displayed on LCD screen that is installed inside the house, residents of home can improve their sense of comfort through knowing of temperature and humidity inside the house, If the indoor temperature exceeds 30°C and/or indoor humidity exceeds 50% then the vacuum fan will operate directly and getting real time notifications that send to smart phone for house owner on Blynk platform, this procedures will improve air quality in the closed place (home), figure 1 shows the results on Blynk platform.

2.2 Gas Leak Detection System

Gas sensor (MQ2) is located inside the kitchen. This is very important sensor for safety. This sensor is very sensitive to natural cooking gas, even can sense the smoke. Many accidents have been happened around the world because of gas leakage that may cause house explosion. Also, gas leakage can cause choking to people inside a house. The action that the smart home system can do for the gas leakage is turning on the vacuum fan and the RGB LED will turn to red. Also, the alarm will be on for 150ms

then stop and back again and sending notifications through emails to home owner smart phone. This scenario will continue as the gas sensor sense gas leakage. When there is no gas leakage the alarm, vacuum fan will stop and the RGB LED will turn to green.

2.3 Firefighting System

Flame sensor can be used inside the house for the detection of fire. This sensor contains an infrared sensor (IR) to detect the light of fire and give a signal to arduino to activate the alarm system. The alarm will continue until the fire is extinguished. Notifications through emails can be sent to the house owner smart phone. Figure 2 shows the results on Blynk platform.

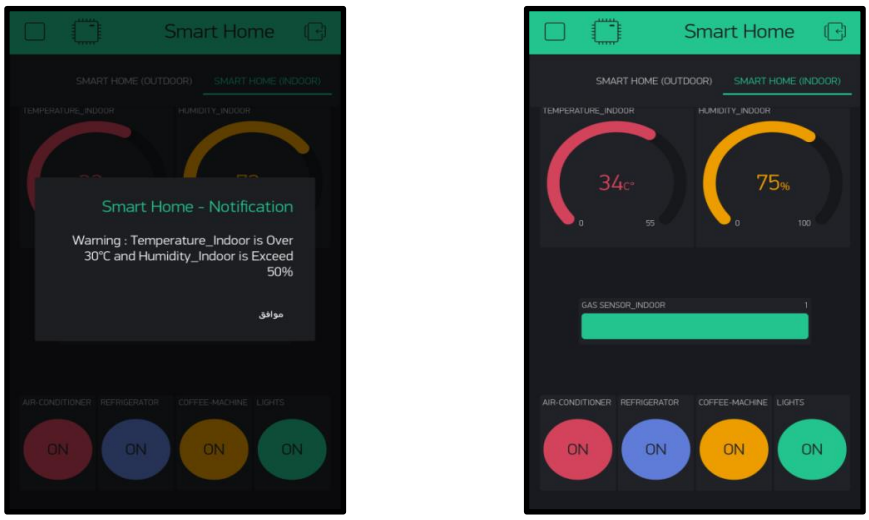


Figure 1. Results on Blynk platform and incoming notifications

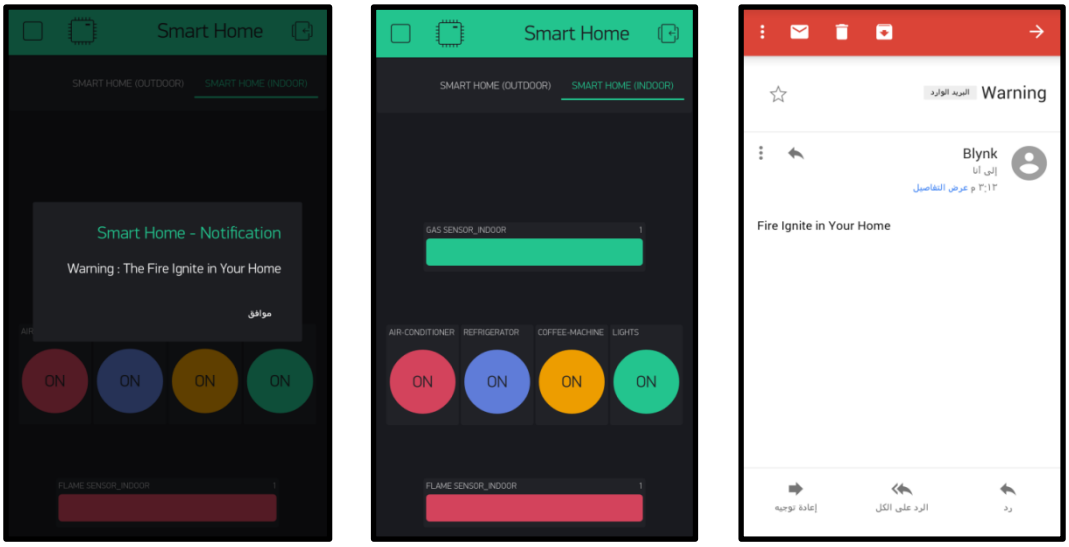


Figure 2. Results on Blynk platform when fire takes place

2.4 Outdoor and Indoor Lighting Systems

LDR (Light Dependent Resistor) can be used indoor and outdoor the house in order to reduce the energy consumption. In the morning all the lights will be off and at night the lights will be on. Motion sensor (HC-SR501) installed and connected inside the smart home to save energy. When there is motion the lights will be on, otherwise they will be off. This sensor can be connected with LDR for maximum efficiency of saving energy.

2.5 Weather Condition Display System

Pressure sensor (BMP180) is used in outdoor to measure the atmospheric pressure with range (300 - 1100) hpa using this sensor prediction can be made for the weather statues. The data of this sensor can be displayed on a screen inside the smart home. Rain sensor is another outdoor sensor. When there is rain an alarm will be turned on for short time then stop, the rain statues will be displayed inside the smart home on LCD screen (no rain, light rain, moderate rain or heavy rain). The LCD screen is installed inside the smart home, it will display the weather condition (atmospheric pressure, outdoor temperature, outdoor humidity percentage and rain statues), figure 3 shows the result on Blynk platform.

Figure 3. Results for weather condition display on Blynk platform

2.6 Alarm System Against Theft (ASAT)

Motion sensor (HC-SR501) is installed outside the smart home to provide the security against theft, in the case of a movement in the outside, buzzer will turn on to alert the residents of the house. Notifications can be sent through emails or SMS message to the house owner.

2.7 Security Door Lock System (SDLS)

RFID (RC522) can be used as outdoor security sensor, the RFID reader is fixed in the main gate for the smart home. Every card has a unique code. This code is saved in the microcontroller. If any unauthorized person wants to enter, the alarm will be on and the RFID reader will not responed.

2.8 Control of turning on and off the refrigerator, air conditioner, coffee machine and lamps

The control section is done by using 4-channel relay module to control the air-condition, refrigerator, coffee machine and lights. More relays can be used to control more devices; Figure 4 shows the control buttons on the DeviseBit platform displayed on the computer screen. Figure 5 shows the proposed smart home system and figure 6 shows the real connection of the smart home system.

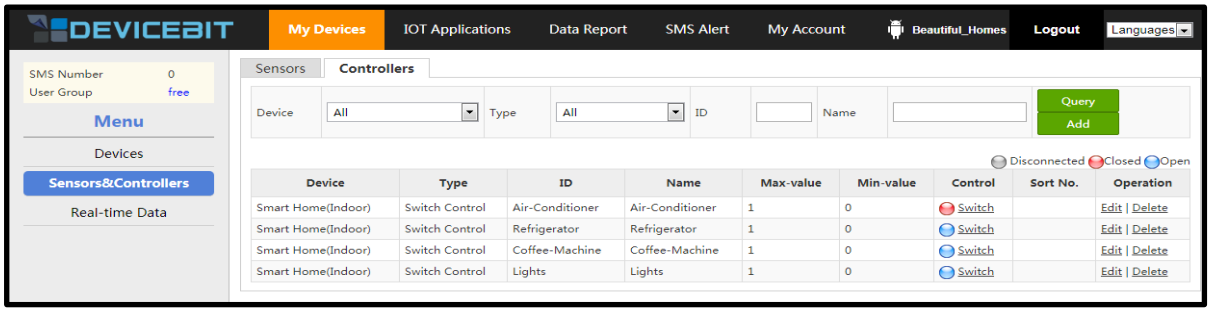


Figure 4. Results on DeviceBit platform for controller on PC

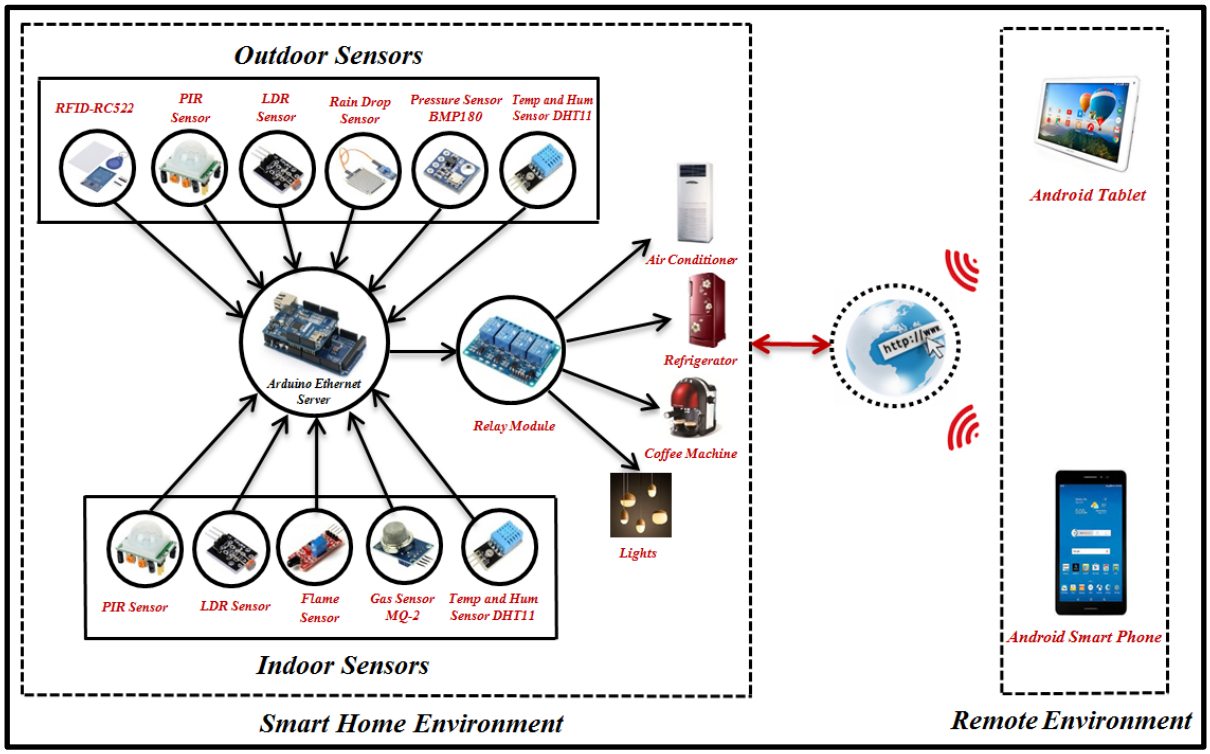


Figure 5. Proposed smart home system

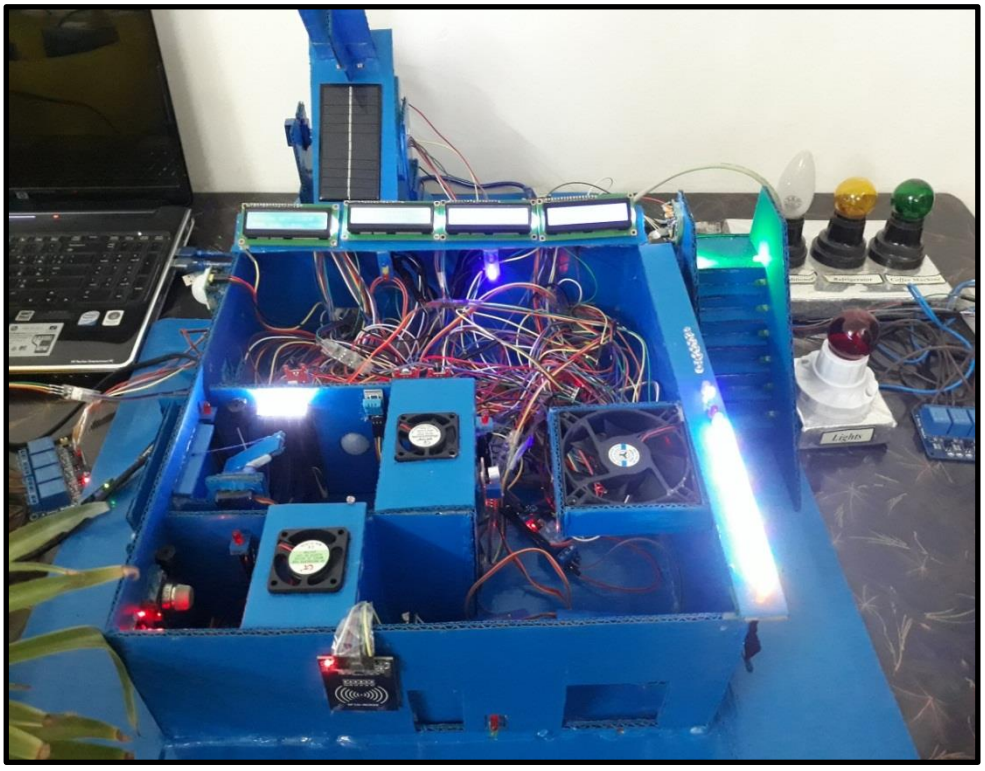
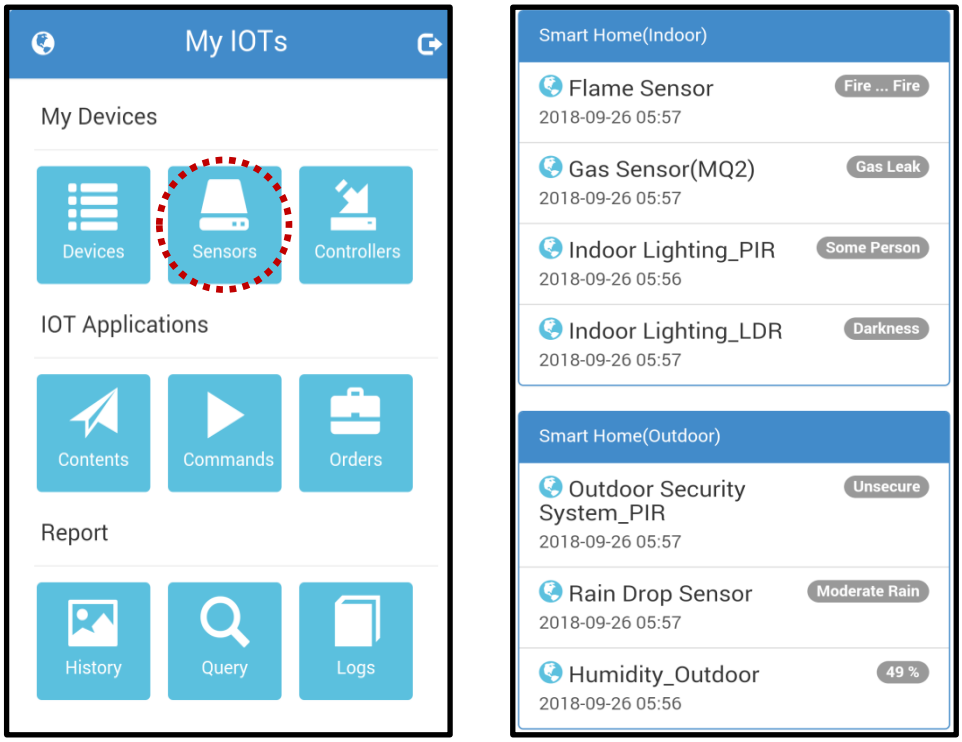


Figure 6. Real connection for proposed smart home system



(a) **(b)**

Figure 7a,b. Results on DeviceBit platform for indoor and outdoor sensors on smart phone

III. CONCLUSION:

In this paper, a proposed smart home system is presented based on Wi-Fi and IoT. This system is flexible, low cost, and gives the home owners the capability of monitoring and controlling home environment from anywhere in the world. Smart home is not only used to provide luxury and comfort, but is also a distinctive and effective way to reduce monthly expenses on the several issues including electricity, water and fuel by smart management to these facilities. The proposed system would be affordable and scalable so that new devices can be easily integrated into the system. The system would be user friendly. The experimental results showed that this system is feasible and can be realized. Future work for the proposed system could be on the security door lock system (SDLS) by adding a camera at the door of the home to take an image of a person trying to enter the home using an incorrect card or by breaking the locks. The alarm system against theft (ASAT) for the proposed smart home can be improved by installing several cameras outside the home that will start picturing at the moment that the security system is compromised, some of these cameras tracking the movement of people who have penetrated the protection system. In addition control features with home appliances through the sound as the voice commands are given by the residents of the home to turn on and off the home appliances.

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Authors Biography

Noor Salah Alkhayatt awarded her B.Sc. in Computer Engineering from the college of engineering/ Mosul University /Iraq in 2006. In 2007, she started the work in the same Computer Engineering Department, as engineer and lecturer in control, electronics, microprocessors, logic, and communication laboratories, now she is working towards her master degree in embedded systems for smart cities. Her current research interests include embedded systems and internet of things for smart cities

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