Web Based Access Control of Smart Home Security System

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Abstract

Smart Home is an essential feature for future homes to provide smart automatic services in home daily activities. Smart Home system Framework will require different units to work, such as security system, maintenance system, kitchen system, living room system and other main part of the home. These unit should complement each other's. This work is proposing a solution to the design and implementation of Smart home security system (SHSS) unit. With the Internet of Things (IoT), SHSS has become simpler to design and implement. The control and management of such system will require an interface. The web is an excellent option as an interface with secure access. Integrating the system with the web increases the operation of the system and the interaction with other security department for the future Smart City. In this work, the design and implementation of SHSS is shown. The model has successfully been built and ready for the integration with more units of the smart home and smart city.

Keywords: IoT, Smart Home, MQTT, Web Services, Home Security Systems.

1. INTRODUCTION

With the growth of cities and population size, regular systems and services are not enough. Smart city framework is required to fulfill this almost currently and surely a future demanded service. Table 1 shows the Smart city framework units, one of which is the smart home. Smart home has also different units, such as security system that is should be part of the smart city in the future. Smart Home will provide services, that performs decisions without reference to human, which could be enhanced by an Artificial System (AI) that observe the habits of persons and take actions accordingly. This paper presents a Smart home security system (SHSS) design and implementation. SHSS is using embedded systems, Internet of Things (IoT) and web interface to monitor and control the system. SSHS and any smart city application should increase response performance for services. Time is a main factor in terms of home security, such as smoke alarm or motion detector. SHSS helps in smoke or toxic gases detection, which could be caused by a careless actions or faulty Electrical Equipment. This work present smart solutions to in short time,

discover problems, verify them and act without human intervention. Which helps us to prevent or reduce damage and speed of rescue.

IoT services can be classifieds in static or dynamic services. Static services start with user request only, such as door entry using mobile application or using finger barometric input device or by voice command. In general, IoT devices should work with more than one method to avoid errors in any possible case. After the introduction, a section about Previous studies and System Design and Implementation is presented. Then a section about results and discussion to discuss the system implementation. The paper closes by Conclusion and Future Work and the references referred to in this paper.

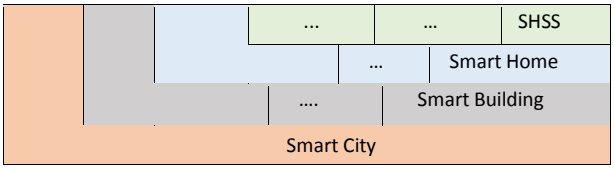


TABLE 1: Smart City Framework.

2.1 Previous Studies

IoT application uses different application protocols, mainly MQTT and Constrained Application Protocol (CoAP) with different enhanced security and operational schema over cloud and edge computing [6] [4]. There are great range of research projects and commercial Smart Home projects, using different types of sensors and actuators, such as camera microphones and Wireless Smoke Detector [19]. Intelligent Door Lock project connects the door of the house to mobile application with security to open a remote door for those trusted [12]. Home motion detector project for motion detection within a household [11]. In Smart doorbell project, the bell can be heard from anywhere connected [8]. One of the IoT application uses IoT for engagement of elderly people in daily activities [18] Also other examples are light bulbs and temperature Dynamic services starts without user request, such as opening Garage, Automatic entry door, light bulbs to operate according to time intervals [17].

Smart system has many operational and functional details and components with support of Artificial intelligence [20]. Embedded system" is not related to hardware alone or software but related to all of them. It is a computer made to do specific function. Therefore, it is compiled system of hardware and software designed to make function [16]. Embedded System Must be Reliable, maintainable and efficient [13]. Embedded systems naturally contain of diverse components, Sensors, Elements transmit, Command-and-control units, Actuators [14]. Different kinds and features of Embedded System can be used in IoT application, such as Raspberry pi and Arduino [1] [10] [5]. Smart homes have some Challenges, such implementation cost, technical awareness and insufficient technical support to maintain, operate and work with these systems [7]. The Internet of Things Technologies has been tested as a use Case Study of Smart Malls [3]. One of the projects presented a Scalable Monitoring System (WiSe-SMS) using IoT without using an application protocol [2].

Layer	OSI Layers	TCP/IP	IoT
7	Application	Application	MQTT
6	Presentation		
5	Session		
4	Transport	Transport	TCP
3	Network	Internet	IP
2	Data Link	Network Access	IEEE 802.15.4 MAC
1	Physical		IEEE 802.15.4 PYS

TABLE 2: Internet Of Things Stack.

2. SYSTEM DESIGN AND IMPLEMENTATION

SHSS is designed using Raspberry Pi 3 Model B and Arduino. The programming language used is Python, is the official programming language for raspberry pi. Message Queue Telemetry Transport (MQTT) is publish/subscribe and lightweight messaging protocol. Table 2 shows the MQTT stack model. A client receives messages from a sensor by subscribing to the topic on the same sensor. In this model, there is no straight connection between a publisher (sensor) and subscriber (client or actuator). The system use cases is shown in Figure 1 and 2. For instance, two cases that almost follow the same actions, but has a different reactions as shown in figure 2 and 3. Following the smart procedure, when there is an intruder, the system takes a reaction without human interference. When smoke is detected by a smoke detector, the reaction will be sent to the Civil Defense to take the message and send a rescue team. Home design is miniature design for home as shown in Figure 3.

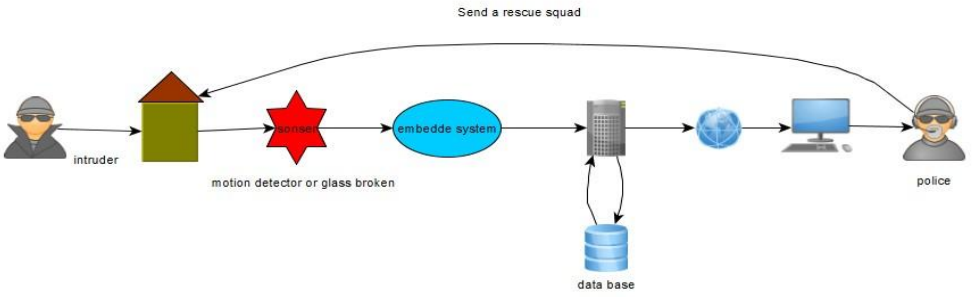


FIGURE 1: Case 1" Intruder".

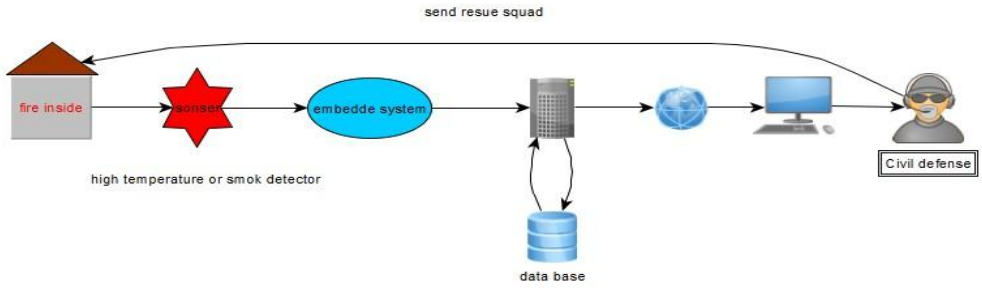


FIGURE 2: Case 2" Intruder".

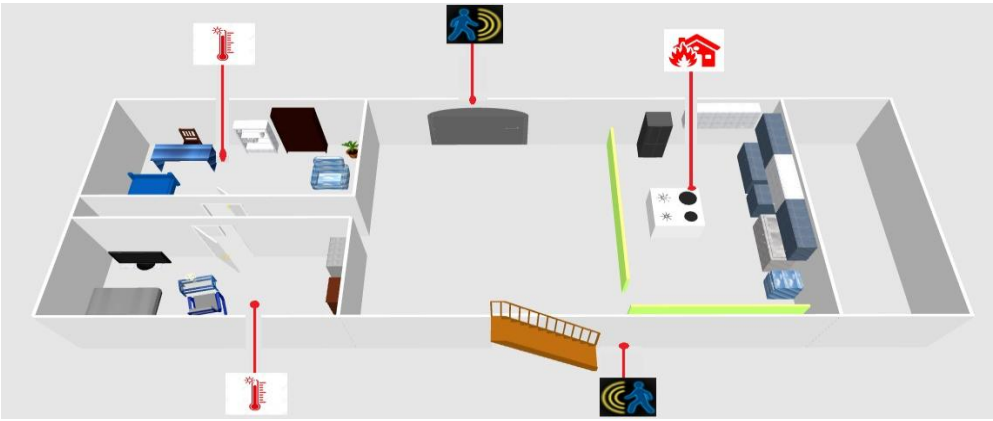
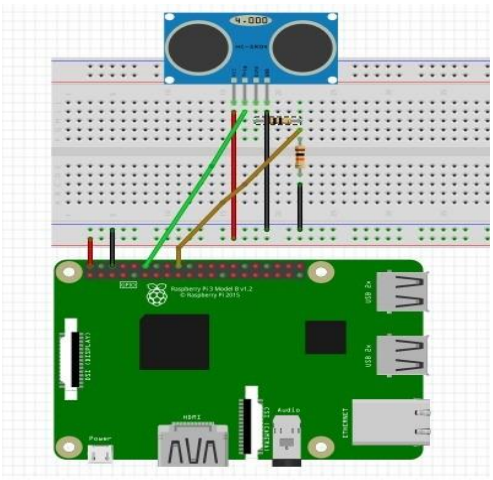


FIGURE 3: Home Design.

The system consists of Ultrasonic sensor, temperature and humidity sensor, Gas sensor, Raspberry pi ,Raspbian OS, Power Supply, 2A microB USB power supply, HDMI cable to Connect Raspberry Pi to a Screen, Monitor as a display for the raspberry pi, Keyboard, Mouse

and SD card Reader .SD Card and microSD card are used to store files and software to use on your Raspberry Pi, such as NOOBS and Raspbian. ”Mosquitto” distribution is used as MQTT broker and client with access control by a username and password [15]. Python web framework called Flask to shows up the Raspberry Pi into a dynamic web server [9]. Ultrasonic is a sensor that measure the distance to an object by using sound waves. Connection is shown in figure 4(a) and output is shown in figure 4(b). Connection of the temperature and humidity sensor is shown in figure 5(a) and output is shown in figure 5(b). Connecting the Gas sensor as shown in figure **6(a)** and the output is shown in figure **6**(b).

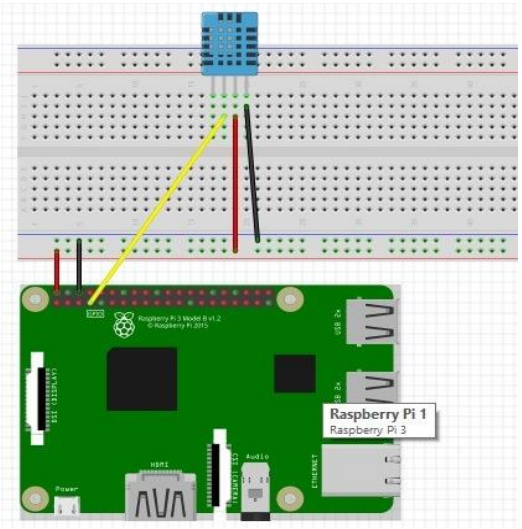


(a): Connection of Ultrasonic.

```
Python 3.5.3 (default, Jan 19 2017, 14:11:04)
[GCC 6.3.0 20170124] on linux
Type "copyright", "credits" or "license()" for
>>>
================== RESTART: /home/pi/ultrasonic
Measured Distance = 3.6187 cm
Measured Distance = 3.6023 cm
Measured Distance = 3.5819 cm
Measured Distance = 3.6187 cm
Measured Distance = 3.6595 cm
Measured Distance = 3.6187 cm
Measured Distance = 3.6391 cm
Measured Distance = 3.6555 cm
Measured Distance = 3.5982 cm
Measured Distance = 3.6800 cm
Measured Distance = 3.6595 cm
Measured Distance = 3.6514 cm
Measured Distance = 3.5083 cm
```

(b): Output of Ultrasonic.

FIGURE 4: Ultrasonic Sensor.

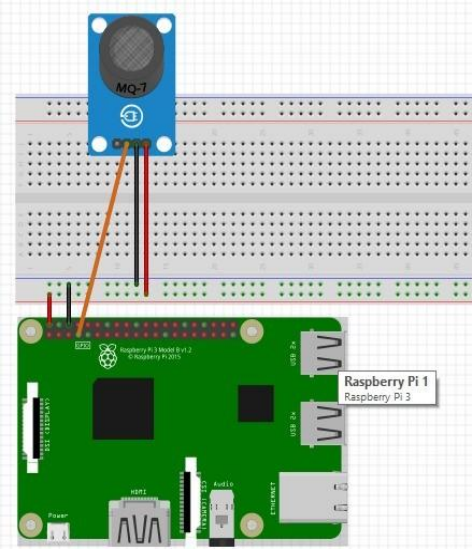


(a): Connection of Temperature Sensor.

```
Python 3.5.3 (default, Jan 19 2017, 14:11
[GCC 6.3.0 20170124] on linux
Type "copyright", "credits" or "license()
>>>
====================== RESTART: /home/pi/
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
Humidity = 16.0 %; Temperature = 23.0 C
```

(b): Output of Temperature Sensor.

FIGURE 5: Temperature Sensor.



(a): Connection of Gas Sensor.

```
alive
Sensor detected action!
Sensor detected action!
alive
alive
alive
Sensor detected action!
Sensor detected action!
alive
alive
alive
alive
alive
alive
alive
alive
alive
alive
alive
```

(b): Output of Gas Sensor.

FIGURE 6: Gas Sensor.

3. RESULTS AND DISCUSSION

We have three parts of SHSS system, home, police and the other for civil defense. The home requires watching for two entrances and two rooms and one kitchen. If there is a warning it will show that to the police or civil defense, which should be using MQTT. The main Home Interface will look like the page shown in figure 7.

In each icon there is a sensor that can detect something like gas, motion or high temperature. For Entrance 1 and 2, a limiting distance is set for the window sensor to alert the user and the Police Department as shown in figure 8(a) and 8(b) for entrance 1 and 2, respectively. If the sensor detects a motion for less than 15 cm, a warning is sent to the homeowner and the police. A pop-up massage is displayed for entrance 1 as shown in figure 9 and the same applied for entrance 2.

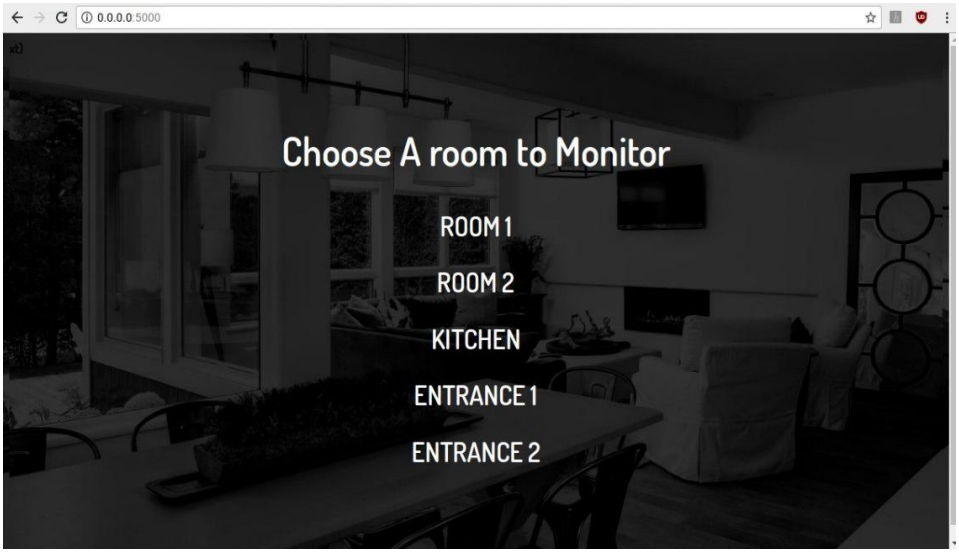
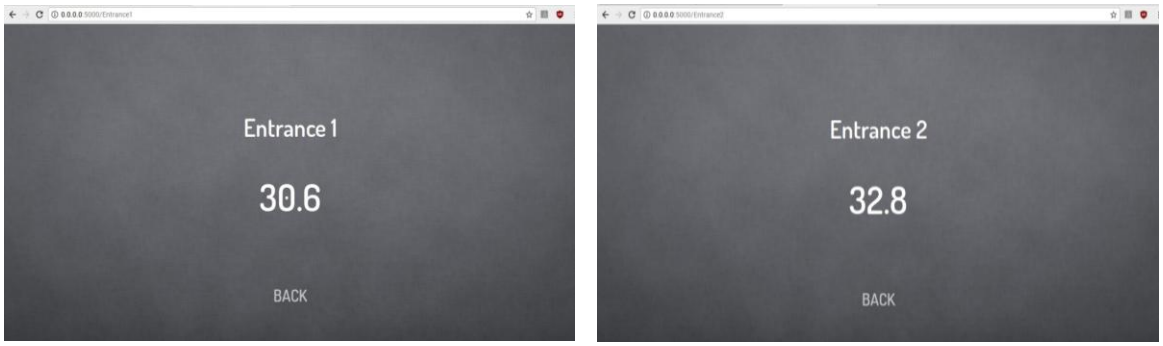


FIGURE 7: The Main Home Interface.



(a): Entrance 1 Interface. **(b):** Entrance 2 Interface.

FIGURE 8: Entrance Interface.

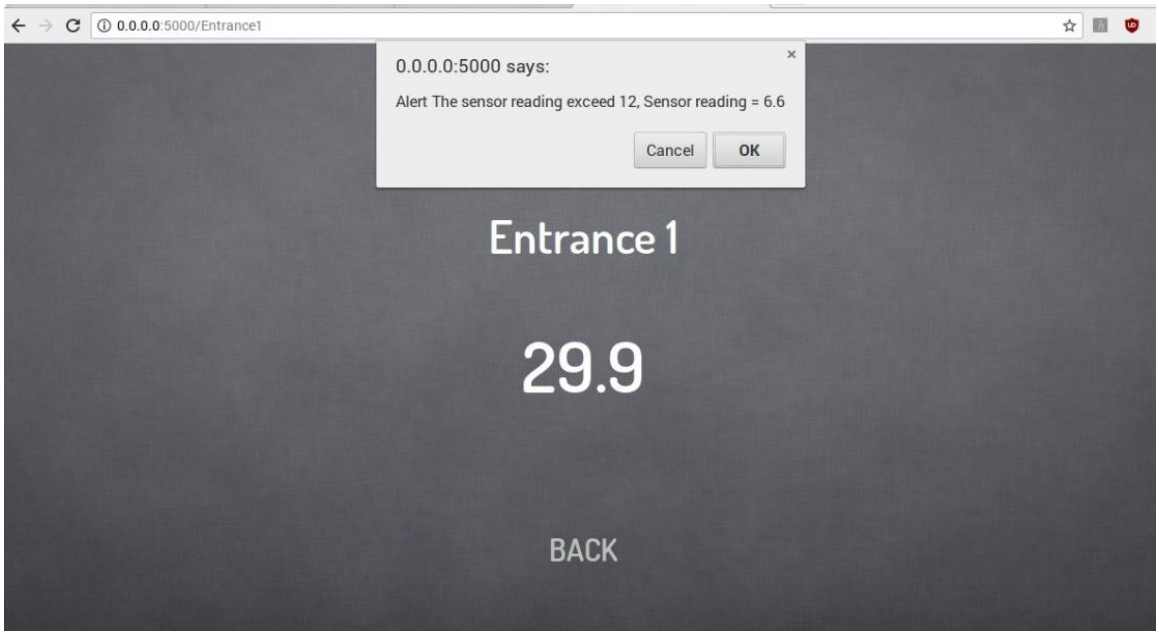
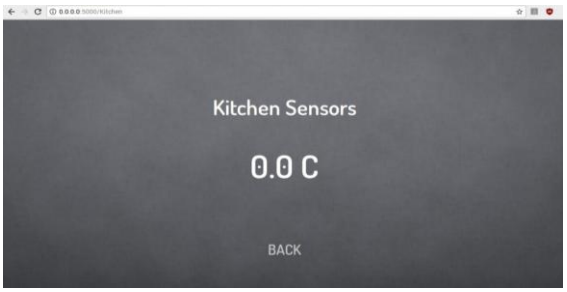


FIGURE 9: Entrance 1 with Pop Up Window.



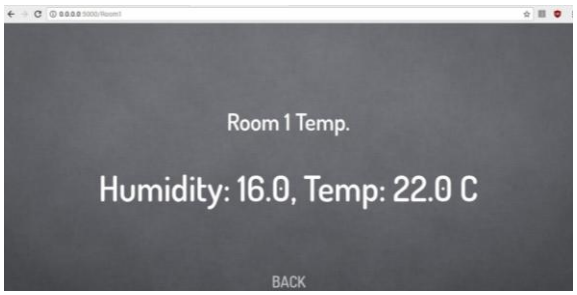


FIGURE 10: Kitchen Interface. **FIGURE 11:** Room 1 Interface.

For the Kitchen, there is a gas sensor connect that detect the Gas Leak. It will open a pop-up window in case of warning. Also, the Temperature and humidity sensor shows pop up in case of warning as shown in figure 10. If the sensor detect gas, it will turn to 1. For Room 1, there is a Temperature and humidity sensor. We have shown pop up the Temperature and humidity of the

room to show the information to the homeowner as shown in figure 11. For Room 2, the same as the Room 1.

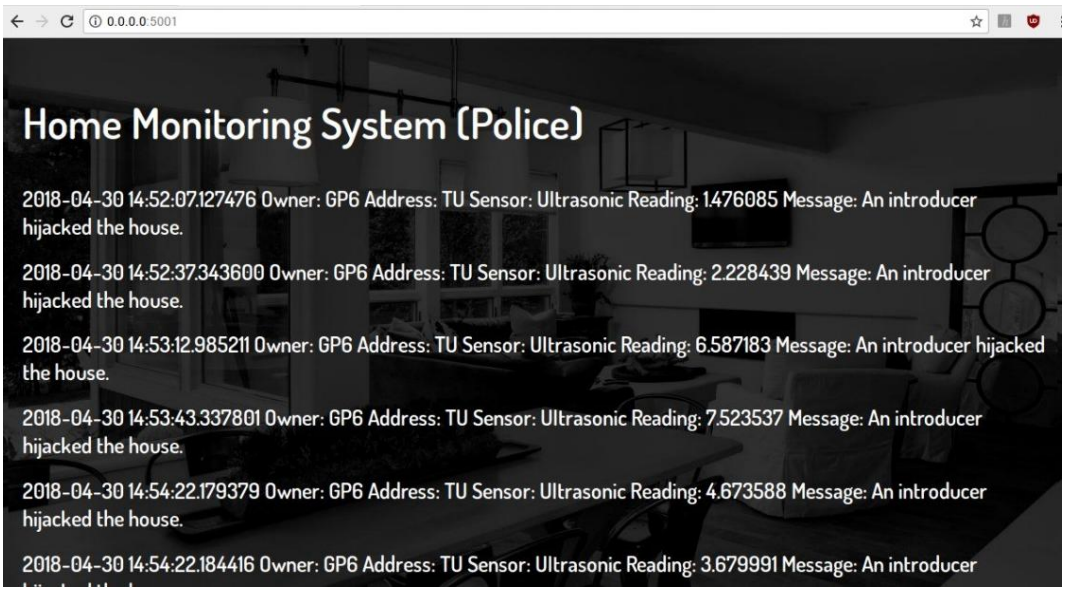


FIGURE 12: Police Page Interface.

The system will contact the police by warning message as shown in figure 12. It will display the time and the date and the location address for the home for every warning. For the civil defense, the same as the police warning messages but with different sensors. The main goals of this work are achieved by running the web page and python code using raspberry pi and reading the sensor and display it in the web page and send the warning to the police and civil defense.

4. CONCLUSION AND FUTURE WORK

Home security solutions is essential in the future of smart city. With the IoT popularity, Home security systems are expected to decrease in cost and increase in availability and performance. IoT enhanced by the cloud computing and web services, such system is expected to get simpler to install and implement making such studies are very important. The integration between IoT and application protocols, such as MQTT, and Web servers open wide range of applications and open the doors for using web technologies based on what so called Web of Things (WoT). One of the main challenges of the smart city and smart home application is the structured data integration between separate system from different vendor. Such System can be integrated with other systems using the Semantic Web (SW) with the support with an ontology to help the integration with other system as one system.

Connect the sensors to the Web with dynamic web page, and pop up message, help in increasing the dynamic interactions between machine and human. As well as the connection between different systems, such as the police and other departments to provide easy secure systems integration. Such research opens great range of research and commercial challenges for such systems. No one corporation with one solution will be able to provide complete solution for smart city application.

Therefore, it is very clear that the only solution is to agree on messages transaction between units of the smart city framework. Implementation is not a problem if different from system to system. To complete such mission, the governance of such mega projects need to specify the machine to machine and machine to human interaction and the technologies associated such as SW.

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