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Security and Automation using Raspberry Pi and Arduino for Home

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Abstract - *This project here is an amalgamation of various aspects of IoT, Web design and Networking put together in order to function as an ecosystem. The goal here is to put together a competent and robust system of IoT that includes hardware as well as software running together in unison to provide the user with a seamless home automation environment. Security and Automation using Raspberry Pi and Arduino for Home (SARAH) uses a web base application where the user controls each and every aspect of the proposed system. This project tackles the Everything IoT race by putting the versatility of the development environment that a Raspberry Pi provides along with the connectivity and expansion options that are provided by Arduino.*

We here have created an ecosystem of interconnected devices that functions locally between a Raspberry Pi rather the using a web-based service thus making it extremely secure and redundant to an array of web-based attacks. However, if somebody is to access the system remotely, they can do that via an open-source service known as VNC or Virtual Network Computing. We've used an open-source service known as Real VNC server that uses 256bit AES encryption making it extremely safe for personal use without worrying about any data or privacy breach. This system while running on a web access Wi-Fi router is totally devoid of any internet access as it uses a static IPv5 address.

Cyber Security is one of the most important aspects of the domain called Information technology as there are numerous threats that are just looking out for a device to exploit. Anything that is connected to internet and uses user data is susceptible to at least some kind of a cyberattack. Any compromised device is a threat to the privacy of its' user. Thus, in this paper, we involve an IoT system as well as it's secure deployment so that the system is secure as well as well functioning in every way.

Key Words: SARAH, IoT, Raspberry Pi, Arduino, Cyber Security, VNC

1.INTRODUCTION

This paper Demonstrates our project named SARAH (Security and Automation using Raspberry Pi and Arduino for home) that deals with the ever-expanding leisurely needs of urban citizens as well as catching on with the modern-day trends of IoT. This project also goes a long way in helping the elderly as well as the disabled as it aids them with the possibility of controlling temperature, lights, fans etc. at the comfort of their fingertips. While heavily aiding to the convenience of its' user, it also provides them with the luxury of remotely controlling the appliances that are connected to the system.

Our project is compiled out of several parts listed below.

In this paper, we examine the complete wireframes of the project in detail as well as the possibilities of making it safer with the abidance of some cyber security protocols to make sure that the system is safe and cannot be compromised in any way thus making SARAH immune to malicious attacks.

2. DEVLOPMENT

This part involves the development of a web application with the use of HTML, CSS and JavaScript. This application runs run locally on the Raspberry Pi acting as a host to the entire system and allowing us to control the functions on other computers and smart phones using VNC (Virtual Network Computing) [1]. Along with an html-based web page, there is a hardware construction so that the web app can be hosted in an isolated environment. This system is constructed out of a Raspberry Pi that connects to an array of Arduino based ESP8266 Node MCU boards via Wi-Fi [3].

They send and receive signals via MQTT as it is the most efficient way of transferring data over the air while avoiding any kind of interception. The network however has a crucial dependency on Wi-Fi network for its' operations as that is the only medium the Raspberry Pi communicate with the ESP8266 modules.

3. SCOPE OF SARAH

Current:

- Automation:
  - Residential:
    - Electrical/Electronic Automation
    - Energy Saving
    - Centralized Control & Security
  - Safety & Security:
    - Personal Security:

- Monitoring

- Premises Safety:
  - Fire Hazard Monitoring

- Health-Affecting Variables Monitoring:
  - Quick Change in Temperature
  - Temperature Control
  - Gaseous & Particulate Pollutant Metric & Monitoring

Potential Future Scope:

- HealthCare Monitoring & Hospitals
- Industrial Automation & Robotics
- Optimized service can be easily scaled for up to 800M QPM to handle 5000+ venues for a single machine [6].

4. APPICATIONS OF THE IOT STRUCTURE

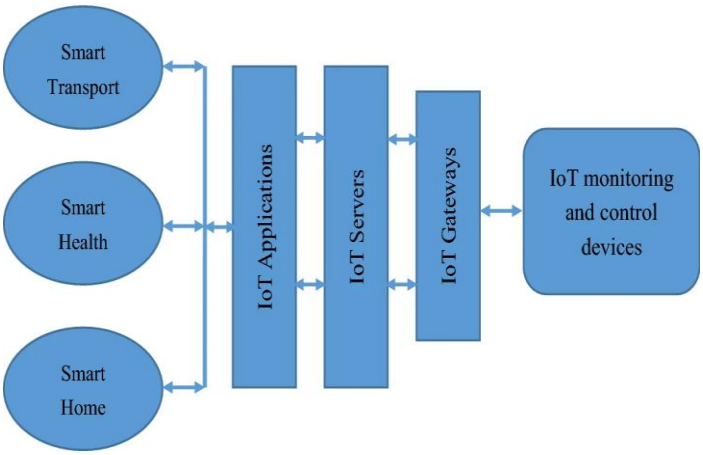

Fig -1: *Applications of Internet of Thing*

5. MQTT

MQTT means Message Queueing Telemetry Transfer and it's used as the standard communication medium across all IoT devices. It's very efficient and also lightweight as the clients used in MQTT are very small and lightweight. The messages queued in MQTT are very small and lightweight so that the bandwidth stays well managed and optimized. It is a Bi-directional communication medium between the host and the client. It can even be encrypted using TLS to set up an authentication system that makes the system more reliable [2].

6. ARDUINO

As an open-source platform, Arduino makes the IoT systems very efficient and convenient to program. In our particular application, Node MCU 8266 is a low cost and low power consumption development board that is built up around ESP8266 Wi-Fi. Module [4][5]. It is programmed with the help of Arduino IDE which is similar to the Arduino programming. Even though the microcontroller supports the IDE, it doesn't come preinstalled with it, thus we need the IDE on a separate device that connects to the board with the help of a compatible extension.

The heart of the project is inarguably an ESP8266 development board as it's a Wi-Fi enabled board that interfaces with the sensors as well as appliances. It makes the system interact over a wireless medium for fast and secure transactions making everything efficient and safe. It also makes the system very dependable as both the MQTT subscriber and the client are powered separately.

FEATURES:

- It is an open-source system.
- Simple to program and interactive
- It's versatile because of Wi-Fi

7. RASPBERRY PI

Raspberry Pi serves as the brains of this home automation system by providing a sanctum to the programs and codes we've written [7]. The processor on the Raspberry is just enough to compile and execute every script and code conveniently. The latest and the greatest Raspberry Pi 4B also functions over Wi-Fi thus increasing its' flexibility over multiple networks and making it easier to deploy in remote areas. It also runs python web view system wide that makes it easier for us to design the interface in HTML, CSS and Java script.

8. CONCLUSIONS

This project concludes upon the development, construction and deployment of a safe and immaculate system that functions in total harmony and has the user experience as its' top priority to provide a sensible and reliable environment. As the nation proceeds towards digitization, IoT stands at the very center of that digital expansion as it allows everything that we imagine to get digitally connected. When we're talking about network or data security, we can never do enough. But for our work here at SARAH, we've

made sure that our system runs safe against cyber-attacks. Along with IoT, there comes an array of inherited security issues that we need to address at it often runs on some form of network. Thus, prototyping and deployment of an IoT system is never a one-off job as there are new ways to exploit network devices being discovered every day.

What we have learned from designing and re-evaluating SARAH so far is that IoT holds a huge scope ahead of itself as there are endless opportunities as anything can be coupled into the IoT setup with the right hardware. This System manages the entire household's electronic appliances so that the user is updated regularly and stays in control all the time.

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