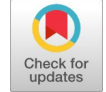


Augmenting Security of Smart Homes

Narsaiah Putta, Raman Dugyala, Pallati Narsimhulu

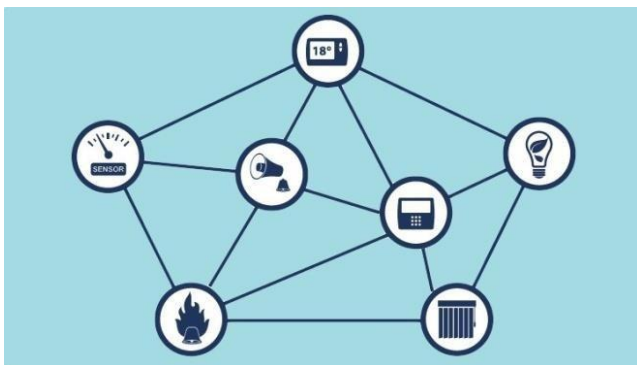


Abstract: The development of new technology and people's propensity to rely on it more and more each year have led to enormous advancements in human technology. The idea of the Internet of Things (IOT) and later "Smart Homes" was one such enormous step. The surge in the smart home sector is due to the introduction of extremely practical and affordable technologies. However, the expanded use has also created a new set of security and privacy risks for those who rely on smart home technology. This article covers the basic idea of smart homes and IOT devices, as well as any current risks and any previous countermeasures that have been suggested.

Keywords: Internet of Things (IOT), Smart Homes, Network Security, Wireless communications and Sensor Networks.

I. INTRODUCTION

A subset of the widely acknowledged and adopted idea of "Internet of Things," the smart home or home automation (IOT). It offers homeowners a wide range of features, including privacy, security, and remotely controlled and automated lighting and sound [1]. Most commonly, smart houses use three well-known protocols, namely WiFi. such as Z-wave and Zigbee [2]. ZigBee and Z wave have only been used in the realm of home automation, but WiFi is more known for its usefulness in general internet applications [3]. They are both mesh network-based and excellent for near field communication.



[Fig.1: ZigBee Based Architecture] [1]

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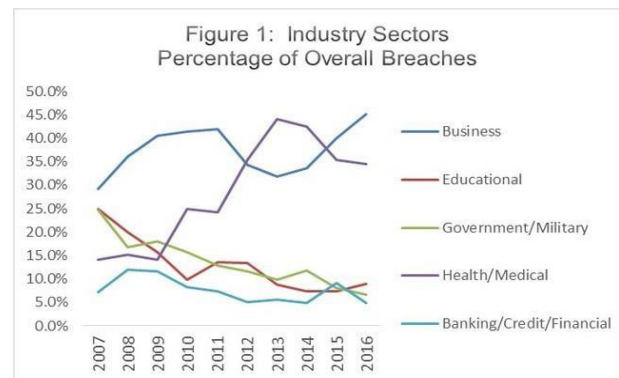
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II. SECURITY CHALLENGES OF SMART HOMES

Due to its interconnectedness, home automation and the IOT concept as a whole face the same difficulties as the rest of the internet. Smart homes are also a source of concern for the three main areas of cyber security, namely confidentiality, authenticity, and access [4].

Interconnected networks and devices were already relatively common in commercial settings before they started to appear in the housing sector [5]. According to a research done in the UK in 2015 [6], network security breaches affected 90% of large firms and 74% of small organizations, up around 14% from the year before [7].



[Fig.2: Increase in Network Security Breaches] [5]

The issue of vulnerability is one more security issue to be concerned about [8]. The privacy of home inhabitants and the security of their data are now much more at danger due to the introduction [9] of device scanning search engines that look for accessible sensors like unprotected cameras and microphones [10].

III. LITERATURE REVIEW

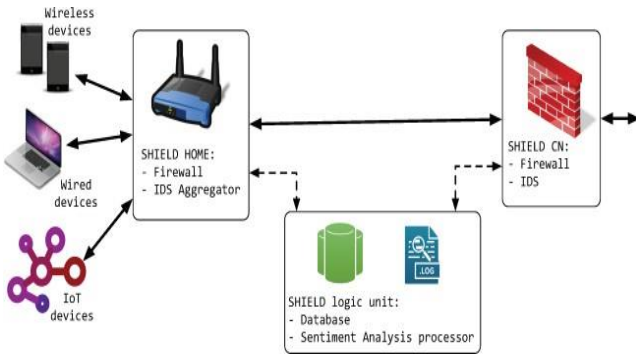
The necessity of addressing and overcoming these difficulties and weaknesses has recently come to light [11], and as a result, numerous solutions have been put forth. This essay lists a few of these remedies, including the following:

A. SHIELD System

The authors of advocate using a novel architecture that is not dependent on existing IOT network standards but nevertheless enables the interoperability of numerous devices in a smart home setting [12].

Setting up firewalls at the Internet Service Provider (ISP) level is standard procedure, but that is insufficient because the intrusion could also occur from within the smart home. using a mobile device that is infected, for instance. It is advised that intrusion detection systems (IDS) be put up both at the ISP and premises level to address this issue.

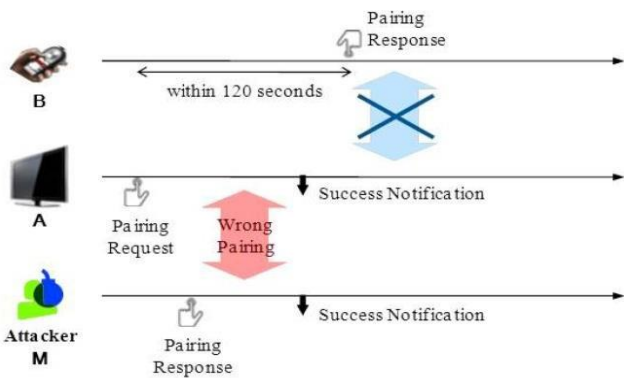




[Fig.3: SHIELD Architecture]

B. Security Enhanced Push Button Configuration

The authors of paper offered a more thorough, "security enhanced push button configuration for smart home networks" by extending the study from paper [14]. By calculating the distances to each target device, their method employs ultrasound sensors to determine whether the pairing message is coming from the intended device. Their strategy essentially suggests a secure handshake connection distance measuring technique that forbids an attacker from fraudulently modifying data coming from outside the range of a smart home [13].



[Fig.4: Security Enhanced Push Button Configuration] [14]

C. Securing 6LoWPAN

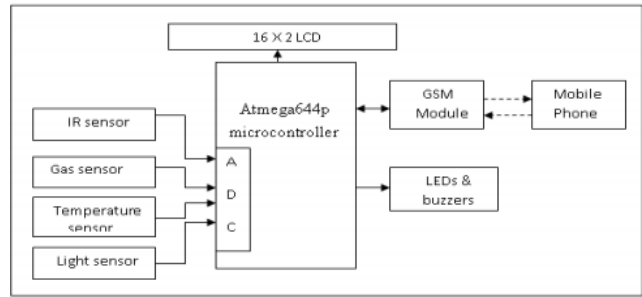
For WPANs, IEEE has selected the 802.15.4 standard [15]. The 6LoWPAN protocol, created to transfer IPv6 packets across 802.15.4 standard networks, is one of the few protocols that operates in accordance with this standard and is intended to be effective in low cost, speed, and energy applications [16].

An "Enhanced Authentication and Key Establishment Scheme for 6LoWPAN networks (EAKES6Lo)" has been proposed by the authors of paper [17]. It is carried out in two stages: The data is encrypted and its integrity is checked in phase 1 using network security methods like AES (Advanced Encryption Standard) and SHA (Secure Hashing Algorithm). Phase 2 settles the confirmation and key foundation processes by establishing a mutual authentication through the exchange of six messages.

D. Security System for smart homes based on GSM

Simple network security is insufficient when discussing smart home security because numerous other elements can compromise a house's security [18]. The authors of paper suggest an interior network of several sensors, including infrared, gas, temperature, and light sensors that are

connected via a microcontroller to a GSM unit and can alert the owners or inhabitants anytime there is a breach or abnormality in the systems being monitored [19].

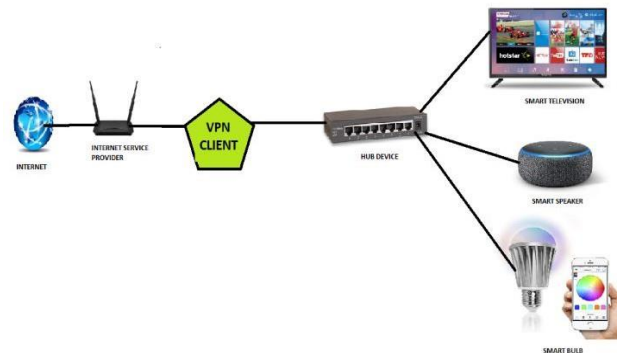


[Fig.5: Security System Design Based on GSM] [18]

IV. PROPOSED SOLUTION

A. VPN Enabled Network Architecture

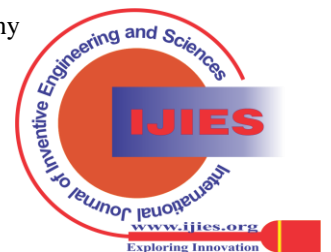
The majority of smart home appliances use the internet in addition to their own low energy standard to gather information for the user, stream videos, music, and other things [20]. The fact that most hub devices are directly connected to the home network of the Internet service provider can make them more vulnerable because an attacker can access it and acquire information there rather easily [21]. In this study, a network architecture for smart homes is proposed, in which a Virtual Private Network (VPN) client is used to connect the hub device to a second ISP connection [22].



[Fig.6: The Proposed Architecture] [22]

The inclusion of a VPN gives the network a different identity, reducing its susceptibility to nearby attacks [23]. As the location being displayed was not the actual one, it also makes it more difficult for any attacker to identify the specified network and then target it [24]. Our suggested architecture essentially consists of three hardware components, as shown in fig. 5. They are, along with their respective roles [25].

- i. **Smart Home Devices:** There is a wide variety of smart home devices on the market today that can control many aspects of our homes, connect to the internet, and even take voice commands. We can see a smart TV, a smart speaker, and a smart bulb connected to a hub device in the image.
- ii. **Hub Device:** There are many different types of hub devices, but the one we suggest is a network hub



device that utilizes a VPN client to link all of the smart home devices to the primary ISP router.

- iii. **ISP Router:** A well-known tool that enables us to access the internet is the internet service provider router/modem.

B. Role of VPN: Here, a VPN client's function is crucially important. We can establish a remote connection to a completely different place using a virtual private network. Because of this network's great privacy and security, it is much more difficult for a smart home system to experience a security breach. We noted that the architecture that we are suggesting is significantly less complex and comparably more cost-effective, despite the fact that the suggested solution does not offer the same level of security and encryptions as the majority of other systems that have previously been proposed. The cost of research and development as well as exclusive programming is also eliminated because all components of our system require simply low-cost software and hardware.

V. CONCLUSION

The complexity of dealing with new and developing dangers that obstruct the efficient and secure operation of the technology used to make our lives comfortable and efficient will increase along with that technology's level of development. Researchers and developers must use a holistic and dynamic strategy to address the security issues that still exist in the field of smart homes and IOT. Attacks can differ in their purpose, style, and even location. The requirement of the future isn't to establish a security standard, but rather fundamental principles that support the creation of various security structures according to the circumstance.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it has been conducted without any external sway.
- **Ethical Approval and Consent to Participate:** The data provided in this article is exempt from the requirement for ethical approval or participant consent.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

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