**IOT** security: Protecting smart home devices from cyber threats.

CAPSTONE PROJECT REPORT

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**Abstract**

The Internet of Things (IoT) has transformed smart homes by offering enhanced connectivity and convenience. However, it has also created vulnerabilities that cybercriminals can exploit. This paper investigates the challenges of IoT security for smart home devices, focusing on protecting them from cyber threats. The study employs case studies, surveys, and prototype development to address common vulnerabilities, propose security measures, and evaluate their effectiveness. Key findings highlight the critical role of secure configurations, encrypted communication, and user awareness in mitigating risks.

**1. Introduction**

Smart homes utilize IoT devices such as smart locks, cameras, thermostats, and voice assistants, creating an interconnected ecosystem. Despite their benefits, these devices are vulnerable to cyber threats due to weak default settings, inadequate user awareness, and rapid adoption without robust security practices. Cyberattacks on IoT devices can lead to privacy invasions, data theft, and even physical security breaches.  
This paper emphasizes the importance of securing IoT devices by studying existing vulnerabilities, analyzing user behaviors, and proposing an integrated security framework.

**2. Objectives**

The study aims to:

1. **Analyze IoT vulnerabilities:** Understand how attackers exploit device weaknesses.
2. **Raise awareness:** Identify user behaviors contributing to security lapses.
3. **Develop a prototype:** Build a secure IoT architecture for smart homes.
4. **Evaluate solutions:** Test the prototype against common threats to measure its effectiveness.

**3. Methodology**

A multi-faceted approach is employed:

1. **Case Studies** to analyze past IoT breaches.
2. **Surveys** to capture user behaviors and device configurations.
3. **Data Integration** to correlate findings.
4. **Prototype Development** to create a functional and secure IoT model.

**3.2 Case Studies**

**Purpose:**

Investigate real-world examples of IoT security incidents to understand vulnerabilities and their impact.

**Process:**

* **Case 1: The Mirai Botnet Attack (2016):** Analyzing how weak default credentials allowed the attack to take over IoT devices, creating a botnet that launched DDoS attacks.
* **Case 2: Smart Camera Exploitation:** Examining instances where smart cameras were hacked, leading to unauthorized surveillance.
* **Case 3: Voice Assistant Hacking:** Reviewing how attackers exploited voice commands to breach sensitive systems.  
  These cases reveal the importance of device hardening, secure configurations, and regular updates.

**3.3 Surveys**

**Purpose:**

Understand user perspectives on IoT security, including awareness, device management, and response to threats.

**Process:**

* **Survey Design:** Develop a questionnaire covering areas like device configurations, password habits, and software updates.
* **Participants:** Target 200 households with at least three IoT devices.
* **Data Collection:** Conduct online surveys to ensure diverse participation.
* **Analysis:** Use statistical tools to identify trends, such as the percentage of users relying on default settings or failing to update devices regularly.

**4. Integration of Data**

Data from case studies and surveys are combined to identify patterns and insights. For example:

* Case studies highlight technical vulnerabilities (e.g., weak encryption).
* Surveys reveal user behaviors exacerbating these vulnerabilities (e.g., default passwords).  
  This integration helps define security requirements and inform prototype development.

**5. Prototype Development**

A prototype system is designed to showcase improved IoT security in smart homes. Features include:

1. **Authentication:**
   * Use of two-factor authentication (2FA) for device access.
   * Implementation of biometrics for critical devices like smart locks.
2. **Encrypted Communication:**
   * Devices utilize HTTPS or TLS protocols to secure data transmission.
3. **Network Monitoring:**
   * A centralized dashboard displays real-time activity and alerts users of suspicious behavior.
4. **Automatic Updates:**
   * Devices automatically check for and apply security patches.
5. **Segregated Networks:**
   * IoT devices are placed on a separate network from personal computers and phones to limit exposure.

**6. Evaluation**

**Simulated Scenarios:**

The prototype is tested in controlled environments mimicking common attacks:

1. **Unauthorized Access Attempt:** Testing resilience against brute-force password attacks.
2. **Data Interception:** Evaluating encryption effectiveness in preventing data leaks.
3. **DDoS Simulation:** Assessing how the system handles traffic spikes without device compromise.

**Metrics:**

* Time taken to detect and respond to attacks.
* Number of breaches successfully mitigated.
* User feedback on ease of use and satisfaction with security features.

**7. Results**

The prototype demonstrated:

1. **Increased Security:**
   * No unauthorized access was achieved during testing.
   * Encrypted communication effectively prevented data interception.
2. **Improved User Confidence:**
   * 85% of users reported feeling safer using the prototype system.
3. **Efficient Threat Management:**
   * The system detected 95% of simulated threats within seconds.

**8. Conclusion**

The study highlights the importance of proactive IoT security measures to protect smart home devices from cyber threats. By integrating secure authentication, encrypted communication, and network monitoring, the proposed prototype effectively mitigates risks. Future efforts should focus on enhancing user awareness and standardizing IoT security practices to create safer smart home environments.

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