SMART ALARM SYSTEM – GROUP 007

1. BUSINESS SITUATION

The current business landscape for home security systems is rapidly evolving with the integration of smart technology. Consumers are increasingly looking for ways to enhance the security of their homes and businesses while also enjoying the convenience of modern technology.

Our smart alarm system offers unparalleled peace of mind and security for homeowners. We offer complete protection against unauthorized entry or intrusion by seamlessly combining Contact sensors, RFID technology, and Motion sensors.
Our customers will feel a sense of security knowing that their property is protected around the clock by our alarm system. By restricting entry to only authorized residents through the use of RFID key cards, our system reduces the possibility of unlawful entrance. Following the detection of an unauthorized entry, our technology provides homeowners with a prompt and 30-second window to disable the alarm using their RFID key card or password. If the prompt receives no response from the resident within the set time, the alarm goes off and the homeowner and law enforcement agencies in the area are notified. In addition, the contact sensors in our system provide an additional degree of protection by identifying any effort to break in through windows, therefore discouraging would-be burglars. In addition, the contact sensors in our system provide an additional degree of protection by identifying any effort to break in through windows, automatically triggering the alarm, and preventing property theft.

Our product operates on a B2C model, serving both homeowners and small businesses. We offer customized home security solutions tailored to the unique needs of each customer, including optional special services based on their desired level of security. Our approach focuses on continuous innovation to make new products and make existing products better, ensuring that we remain at the forefront of providing comprehensive and effective security solutions to all our clients.

2. MOTIVATION FOR ADOPTION

2.1 Problem Statement

Homeowners across the U.S. continue to have serious concerns about the frequency of home invasions and burglaries, even despite a national decline in burglaries. Based on data from law enforcement organizations and the U.S. Department of Justice, 833,280 burglaries were recorded in 2021 alone, impacting almost 9 out of every 1000 families (Vivint, 2024). Even while this is a decrease from prior years, the figures show how dangerous residential property burglaries continue to be. In 2022, the number of burglaries reported to the FBI jumped to 847,522, an increase from 2021 numbers (Hunt, 2024).
Burglaries have far-reaching effects that go well beyond physical harm and loss of goods. Victims of home invasions frequently experience psychological distress, monetary hardship, and an everlasting feeling of insecurity. Furthermore, residents who encounter burglars during the break-in may sustain bodily damage or injuries as a result of it. These incidents not only disrupt the safety and security of individuals and families but also undermine the overall well-being of communities. Alarms and locks are examples of traditional security devices that have offered some degree of protection against break-ins. However, technological developments have brought attention to the necessity for more advanced and proactive security measures. In the present environment, home security requires novel ways that not only identify intrusions but also discourage would-be robbers and speed up reaction times in the event of a breach.

To solve these urgent issues, our smart alarm system business will provide a thorough and proactive approach to home security. By integrating alarm triggers and alerts, homeowners and law enforcement may respond promptly, reducing the possibility of property loss/damage and injury to occupants.
The prevalence of burglary despite the fall in its rates, emphasizes the critical necessity for efficient security measures. Homeowners may enhance the safety of their homes, family, and peace of mind by putting proactive security solutions and cutting-edge technologies into place to combat the constant threat of break-ins and invasions.

2.2 Market Opportunity

The market for smart security solutions is growing rapidly, driven by rising concerns about property crime, safety, and the need for remote monitoring capabilities. The global smart security market size is estimated at USD 32.46 billion in 2024 and is expected to grow at a compound annual growth rate (CAGR) of 13.8% from 2023 to 2030.

3. Our Competition

1. **ADT:** ADT Inc., formerly known as The ADT Corporation, is an American security firm that offers fire safety, electronic security, and other associated alarm monitoring services for homes and small businesses across the U.S. (ADT, 2024). A suitable computer, smartphone, or PDA with Internet and email connectivity is necessary for ADT Interactive Solutions Services, as is the installation and/or activation of an ADT alarm system with monitored burglary service. The operation and upkeep of domestic systems and equipment that are not linked to the services or equipment are not covered by Interactive Solutions Services.

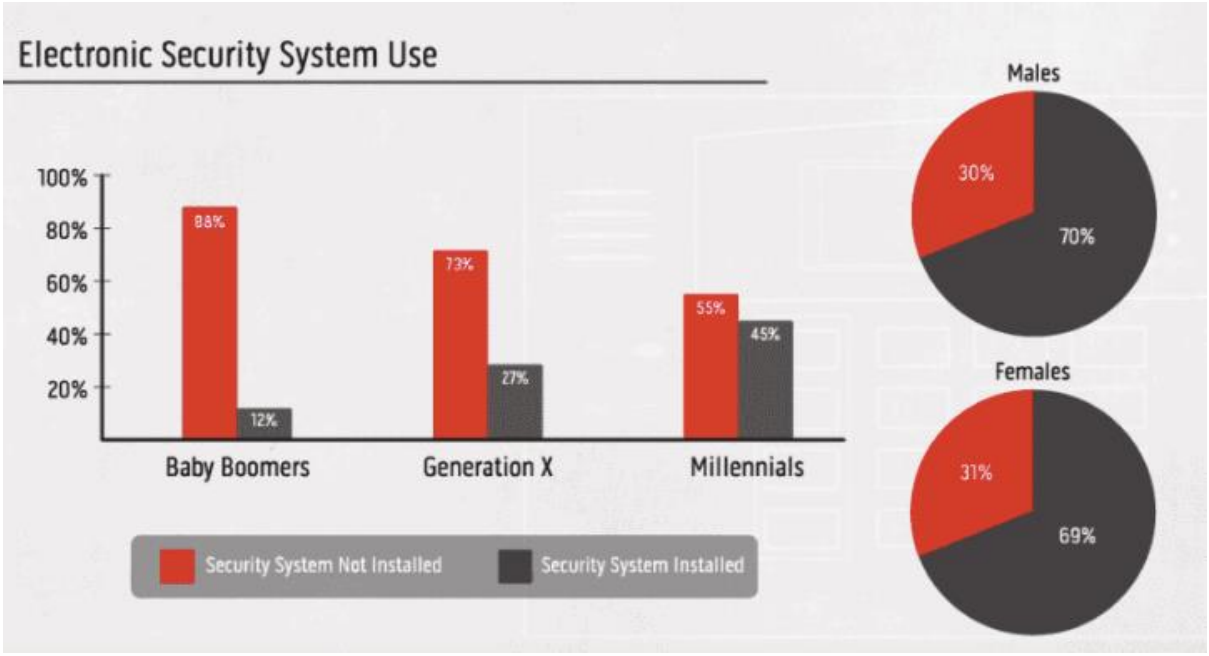
2. **Cove:** Cove Smart, LLC offers a variety of professional equipment, including a hub, a touchscreen alarm panel, indoor and outdoor cameras, anti-burglary sensors, environmental sensors, medical alerts, and key fobs (Cove Security, 2022). The touchscreen serves as the primary interface through which users engage with the system. With the best customer-rated home security system available, Cove is a top provider of home security systems, servicing hundreds of thousands of customers across the US. Modern security cameras and professional-grade environmental and burglary sensors are included in its wireless system. For less than $1 a day, the company offers professional monitoring around-the-clock and responds to emergencies faster than most of its competitors.

3. **Rhombus:** Rhombus Inc., founded in 2016, is a security provider that remotely manages cameras, sensors, access control, and alarms from a central platform. The firm can use its Audio Gateway to stop threats or property damage before they get worse. It can set off an alarm, provide a unique warning, sound the police siren, or speak with intruders directly via two-way communication (Rhombus, 2024). One of the pioneers in the realm of enterprise-level cloud-based physical security is Rhombus. Since being the first to provide cloud security cameras, it has kept coming up with fresh, creative methods to assist clients.

4. Target Market

Our target market is households and small businesses in the U.S. and Canada, but our current focus is the U.S. Our business will expand to Canada once we gain a foothold in the U.S.
In 2023, there were an estimated 131.43 million households in the United States (Statista, 2023). Statistics also show that there are an estimated 33.3 million small businesses in the US in 2024 (Zhou, 2024). An estimated 34.8 million active monitored alarm systems in the US and Canada were recorded in 2022, and this number is expected to grow to 41.2 million by 2027 at a 3.4 percent growth (Markets, 2023). The number of homes and businesses with security systems in

North America, the United States in particular, is higher than in all other regions. So, it's a no-brainer that our target market is the U.S.



The above charts show household security system use by generation and by gender. The bar chart shows a pattern of increased use following each generation. Only 12% of Baby Boomers' homes use security systems, followed by 27% for Generation X, and 45% for Millennials (Kastle System, 2024). With this trend, it is safe to assume that an even higher percentage of Gen Z will use security systems in their home. For this reason, it is important to include Gen Z in our marketing strategy, so that by the time the majority of Gen Zs start buying homes, we will have made sure they can easily identify with our brand and patronize us.

5. IOT TECHNOLOGY

5.1 Hardware Technology

For our project, we will need the following key hardware components:

1. **RFID Readers and Tags**: These are crucial for monitoring entry and exit points. High Frequency RFID readers are attached to the doorframe and RFID tags are carried by the homeowners.

   Advantages of Placing RFID Readers on Doors and Tags on Individuals/Devices:
   a. **Enhanced Security and Access Control**: By having individuals carry RFID tags, we can implement personalized access controls. This allows us to monitor who enters or leaves the premises and at what times. We can also set different access levels for different areas of a home or building, depending on the individual's authorization.
   b. **Ease of Integration**: Doors are a fixed point of entry and exit, making them an ideal spot for installing RFID readers. This ensures that all entries and exits are monitored without the need for multiple reader installations throughout the property. It's generally easier to maintain and secure readers installed on fixed structures like doors.
   c. **Scalability and Flexibility:** This setup allows for easy scaling. Adding more doors with RFID readers or providing additional tags to new users or devices is straightforward. Also installing furthermore features like glass break detectors for high end customers. The tag approach is also flexible because you can easily deactivate a tag if lost or stolen, thereby preventing unauthorized access.

Implementation Considerations:

d. **Security of the RFID System:** Since RFID can be susceptible to cloning and interference, our product uses encrypted tags and advanced RFID systems that offer better security features such as dynamic authentication.
e. **Battery Life and Maintenance**: We ensure that the RFID tags have adequate battery life and are easy to maintain or replace. For passive RFID tags, this is less of a concern as they do not require a power source.
f. **User Privacy:** We understand the implications of tracking individuals via RFID tags in terms of privacy. It's important to ensure that data collection complies with privacy laws and regulations.

2. **Microcontrollers:**
   a. **Raspberry Pi**
      i. **Capabilities**: Raspberry Pi is a powerful microcomputer that can run full operating systems like Linux, supporting complex software and multitasking. It is well-suited for applications requiring substantial data processing or that need to run advanced algorithms.
      ii. **Connectivity**: Equipped with built-in Wi-Fi and Ethernet connectivity, Raspberry Pi can easily connect to the internet and local networks, facilitating cloud interactions and remote access.
      iii. **Use Case**: Ideal for serving as the central hub of our Smart Alarm System, handling data from multiple RFID readers, performing complex data analysis, and managing communications between the system and the user via the internet.
   b. **Arduino:**
      i. **Capabilities**: Arduino boards are microcontrollers that are excellent for real-time operations and interfacing with sensors and other hardware. They are simpler and less power-consuming compared to Raspberry Pi.
      ii. **Connectivity**: While basic Arduino boards do not come with built-in internet connectivity, modules such as the Ethernet Shield or Wi-Fi Shield can be added to enable network connections.
      iii. **Use Case**: Best for managing the RFID readers directly due to their low latency and real-time response capabilities. Arduino can handle tasks like scanning RFID tags, opening and closing circuits, or triggering alarms without significant delay.

3. **Integration and Application in Smart Alarm System**
   a. **Central and Peripheral Roles:** Raspberry Pi will serve as the central server, processing data and making decisions based on the input from various sensors managed by Arduino. Arduino boards will be used at critical entry points to handle RFID reading and immediate device control, such as locking mechanisms or local alarms.
   b. **Software and Firmware Development:** Each device can be programmed with specific tasks in mind. Raspberry Pi could run Python scripts for data analysis and user notification, while Arduino could run C/C++ programs for quick hardware interfacing and sensor management.
   c. **Data Handling and Security**: Ensuring data transmitted between these devices and to the cloud is encrypted is critical to data privacy. Secure MQTT or HTTPS protocols for sending data to the cloud will be Implemented in this product.

5.2 Sensors

Our security system is equipped with advanced features including motion sensors (PIR) to detect any unauthorized movement, door/window contact sensors for monitoring open or closed states, and vibration sensors that alert us to forced entries or glass breaking, ensuring robust and comprehensive intrusion protection.

5.3 Communication

Our security system incorporates various connectivity modules to ensure seamless operation and communication. It features built-in Wi-Fi for wireless internet access, enabling cloud connectivity and remote monitoring. Additionally, optional GSM/4G modules are available for areas without Wi-Fi, providing reliable mobile network connectivity for alerts and system updates, ensuring you stay always connected to your security system.

5.4 Power Supply

Our security system is designed with reliable power supply solutions to ensure continuous operation. It includes a primary power connection along with optional battery backups to maintain functionality during power outages. This dual-system approach guarantees that your security remains active, and your property protected, even in the event of an electrical failure.

5.5 Data Storage

Our Smart Alarm System seamlessly manages the vast amount of data generated by sensors and RFID readers, securely storing every piece of information in the infinitely scalable environment of AWS S3. Our service ensures that your event logs and sensor readings are consistently stored without the risk of exceeding storage limits. Data integrity is paramount, safeguarding against loss and guaranteeing constant availability whenever needed. Access controls are carefully configured to grant entry only to authorized users, ensuring data security and confidentiality.

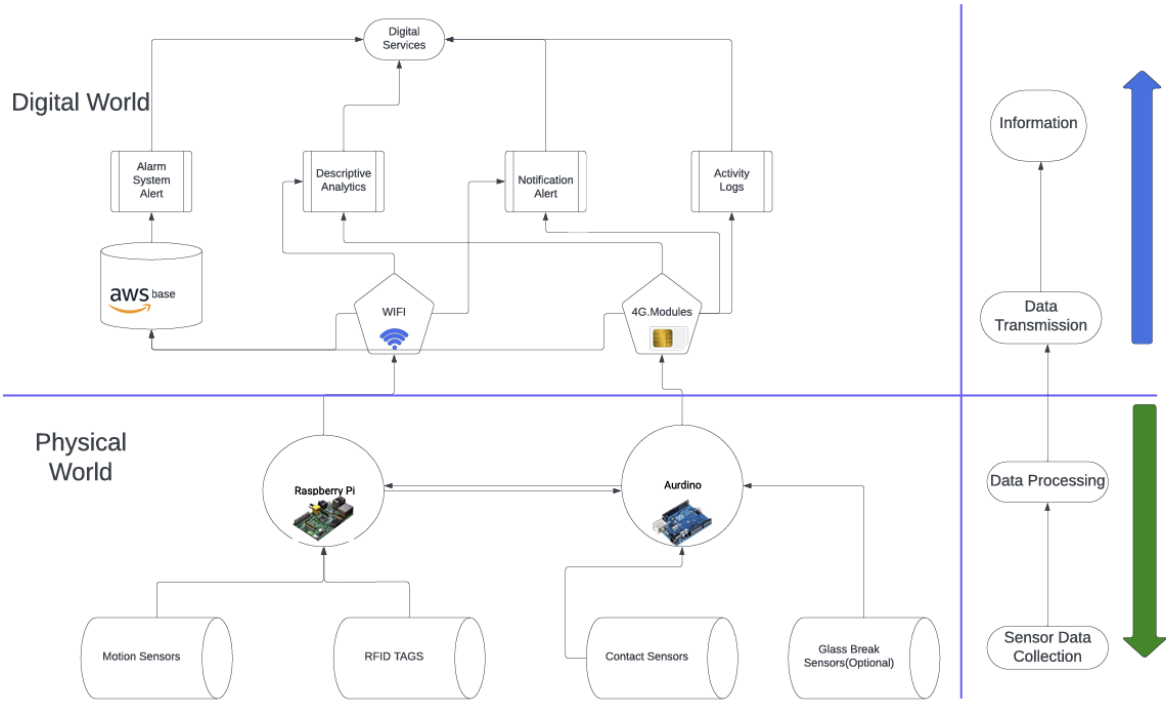
5.6 Cloud

Our security system seamlessly synchronizes with AWS IoT Core, guaranteeing smooth and direct data transfer into S3 buckets. Tailored rules oversee this process, ensuring data is organized for easy retrievals.
Instantaneous Data Transformation: Harnessing the power of AWS Lambda and AWS Glue, our system converts raw data into actionable insights, prepared for analysis, business intelligence, and strategic security decisions.

5.6 Architecture

Here is the depiction of the Digital to physical world created in Lucid chart for our model.

Lucid Chart - Digital-Physical world (2).pdf



Physical Thing: The “thing” is the alarm system that incorporates several devices like the control panel (with RFID reader), RFID tags/key, alarm sirens, contact sensors, glass break sensors, and motion sensor.
Digital Service: Activity log, descriptive analysis, and customer/law enforcement alert

6. DATA AND ANALYSIS

6.1 Data Collection

The data collected from sensors will include:

1. **RFID Tag Data**: Information about which tags are present or absent at given readers, indicating whether a door or window has been opened or closed.
2. **Motion and Contact Sensor Data**: Indications of any movement detected in the vicinity of the sensors or if any secured entry points have been tampered with.
3. **Timestamps and Event Logs**: Each sensor activation will be logged with a timestamp for detailed tracking.

6.2 Data Analysis

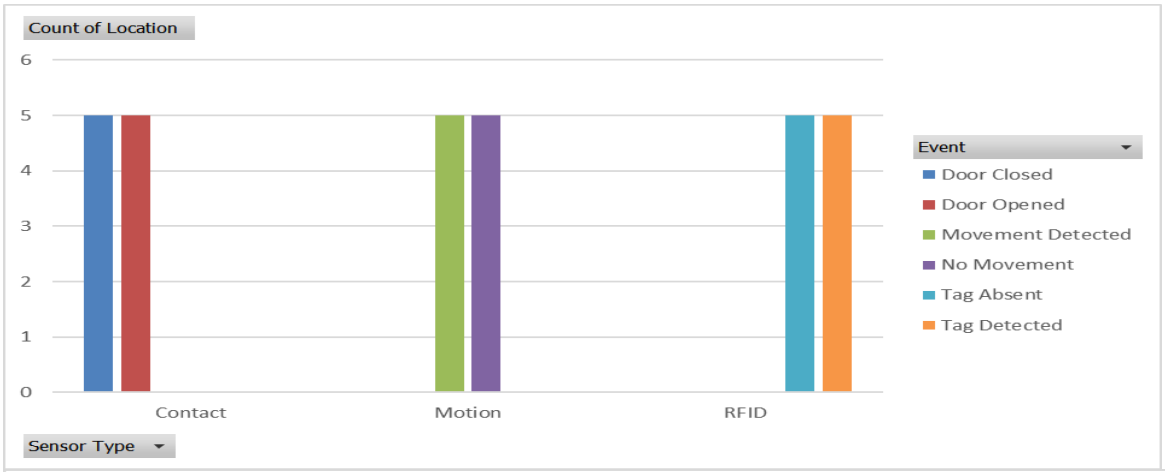
The collected data can be analyzed to provide insights such as:

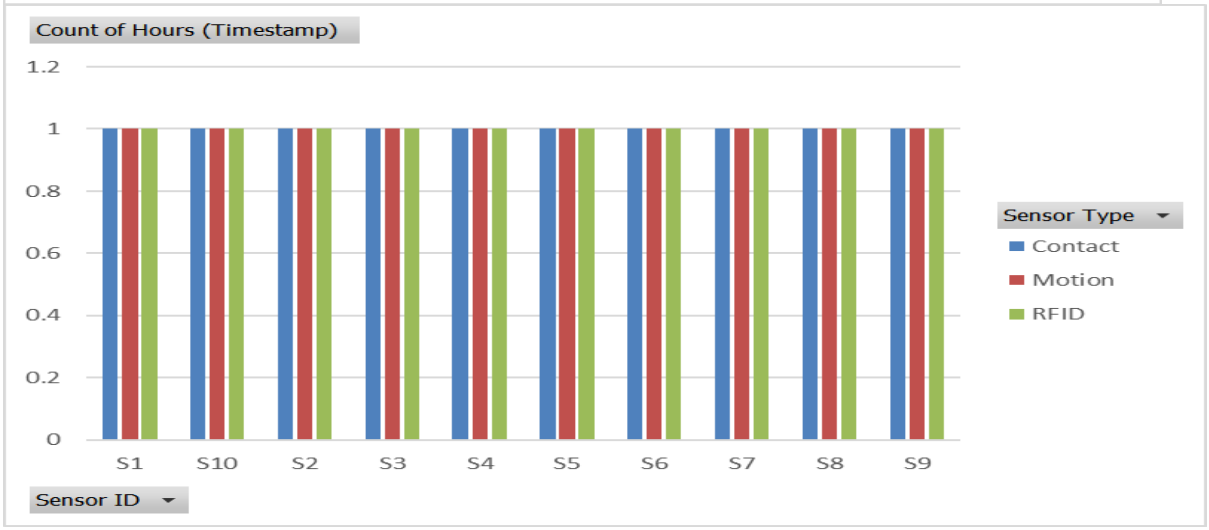
1. **Intrusion Detection:** We would Analyze patterns of entry to detect unusual behaviors or unauthorized access.
2. **Historical Data Analysis**: We can use historical data to understand usage patterns and potentially predict times of higher security risk.
3. **Real-time Monitoring**: We can Implement algorithms that can process data in real-time to instantly alert users about potential security breaches.
4. **Integration with AI**: Employing machine learning algorithms to improve the system’s predictive capabilities and reduce false alarms.

7. BUSINESS VALUE DERIVED FROM IOT DATA

The business value derived from the data collected through IoT smart locks and access control systems is significant and multifaceted. Firstly, enhanced security and convenience, such as remotely managing access permissions and monitoring entry logs, can lead to higher customer satisfaction and trust. This enhanced convenience may even reduce the need for physical presence of clients on-site where locks are installed, saving time and resources for both customers and businesses. Additionally, the data collected from these systems can be integrated into future iterations of smart home security systems, contributing to ongoing refinement and improvement.

Here we have made an Excel Sheet, this would be how the Data collected would look from the sensors. We can get basic insights about the events that occurred from this data.





Note: These Insights have been made by the dummy excel sheet using Pivot charts.

Excel: Dummy_Security_System_Data.xlsx

8. BUSINESS MODEL

Our smart alarm system is designed around the innovative **Razor Blade business model**, which focuses on generating continuous revenue streams through supplementary products and services after the initial sale. This model ensures long-term customer engagement and sustainable business growth. Here's how we apply this model to our security solutions:

1. **Initial Sale**: We offer the basic hardware kit at a minimal markup. This includes essential components like the main control unit, a set of sensors, and standard RFID tags. This low upfront cost makes our system accessible and attractive to a broad range of customers, from residential homeowners to small business owners.
2. **Subscription Services**: After the initial purchase, customers can subscribe to our premium services. This includes enhanced monitoring features, cloud storage for comprehensive event logs, real-time alerts via SMS or email, and regular system maintenance checks. These subscriptions are available on a monthly or yearly basis, providing flexibility to suit different needs and budgets.
3. **Expandable Components:** We understand that each customer's security needs are unique. Therefore, we offer the ability to customize and expand their systems with additional sensors, advanced RFID tags, and other security enhancements. These components can be purchased separately at any time, allowing customers to scale their security system as their needs evolve.

4. **Software Updates:** Regular firmware and software updates are part of our commitment to maintaining the highest level of security and functionality. These updates are provided as part of the subscription service or available as one-time purchases, ensuring that all systems stay up to date with the latest security features and improvements.

8.1 Implementation Strategy

Our approach begins with rigorous prototype development, where each component is tested for integration and performance. Following successful prototype validation, we conduct a pilot project in a controlled environment, such as a residential area, gathering valuable user feedback. This feedback informs further refinement of the product before its full-scale deployment.

Compliance and Data Security: We prioritize compliance with local data protection and privacy. Our systems will be designed to ensure the security and confidentiality of user data, particularly when transmitting over the Internet.

By leveraging this business model, our smart alarm system not only provides robust security solutions but also ensures ongoing innovation and improvement. This strategy not only satisfies the immediate security needs of our customers but also fosters a long-term relationship through continuous service and support, creating a win-win scenario for both our customers and our business.

Initial Installation Costs with Hardware Ranges used in our Razor Blade Business Model

1) **HF RFID Reader:**
   a) **Cost:** $800 each
   b) **Range:** Typically, up to 2 meters, depending on the environment and type of RFID tags used.
   c) **Use:** Capable of monitoring entry points with high accuracy for both entry and exit tracking.
2) **Passive RFID Tags:**
   a) Cost: $5 each
   b) Range: 1-5 meters depending on the RFID reader frequency, since we're using a High Frequency Reader passive tag would be optimal
   c) Use: Enables authentication for cardholders (homeowners) entering the premises.
3) **Control Unit:**
   a) **Cost:** $200
   b) **Range:** Central control unit that connects and manages all peripherals within the system, no physical range but network range depends on Wi-Fi or Ethernet capabilities.
   c) **Use:** Acts as the hub for data processing and connectivity, interfacing with sensors and the internet/cloud.
4) **Other Sensors:**
   a) **Motion Sensor (PIR):**
      i) **Cost:** $50 each
      ii) **Range:** Typically, 5-12 meters (16-40 feet) with a conical detection range of 80-100 degrees.
      iii) **Use:** Ideal for detecting movements within specific areas, such as hallways/ rooms or Garage.
   b) **Contact Sensor (Door/Window):**
      i) **Cost:** $30 each
      ii) **Range:** Effective immediately at the contact point, detects when a door or window is opened or closed.
      iii) **Use:** Essential for monitoring the status of doors and windows, alerting the system to unauthorized openings.
   c) **Installation and Setup Cost:** $0
      Professional installation ensures optimal placement and integration of all components for maximum effectiveness; we would provide the product with 0 Installation cost.

5) **Monthly Service Costs:**
   a) **Basic Subscription Fee:** $25 per month (includes cloud connectivity, basic event logging, and notification services).
   b) **Maintenance Fee:** $15 per year (covers regular servicing, firmware updates, and potential minor repairs).
6) **Optional Additional Services:**
   a) **Additional Sensors:** $60 per sensor (one-time fee for additional door/window contact sensors or motion sensors).
   b) **Premium Support:** $15 per month (24/7 support with priority troubleshooting).

8.2 Complete Initial Cost Summary

Component	Cost (each)	Range/Use
HF RFID Reader	$800 x 2	Up to 2 meters
Passive RFID Tags	$5 X 4	Enable Authentication
Control Unit	$200	Central control, network range depends on connectivity
Motion Sensors (PIR)	$50 X 2	5-12 meters (16-40 feet), 80-100 degrees conical detection
Contact Sensors (Door/Window)	$30	Immediate at contact point, detects open/close
Emergency Security Horn/Siren	$10	The device is triggered when intrusion is detected.
Installation and Setup	$0	Professional installation for optimal component integration
Basic Subscription Fee (Monthly)	$25/month	Cloud connectivity, basic event logging, notifications
Maintenance Fee (Yearly)	$15	Covers regular servicing, firmware updates, minor repairs

Component	Cost (each)	Range/Use
Additional Sensors (Optional)	$60 each	Expand system as needed
Premium Subscription (Optional Monthly)	+ $25/month	24/7 support with priority troubleshooting

8.3 Cost Projection

Standard User Cost Breakdown (2 Years):

- HF RFID Reader (2 units): $800 x 2 = $1600
- Passive RFID Tags (4 units): $5 x 4 = $20
- Control Unit: $200
- Motion Sensors (PIR) (2 units): $50 x 2 = $100
- Contact Sensors (Door/Window): $30 X 2
- Emergency Security Horn/Siren: $10
- Maintenance Fee (Yearly): $15 = $15
- Installation and Setup: $0
- Basic Subscription Fee (24 months): $25/month x 24 = $600

Total Estimated Cost (Standard User) for 2 Years: $1970 + $600
Sale Price: Net cost + 30% margin = $2599

Premium User Cost Breakdown (2 Years):

- HF RFID Reader (4 units): $800 x 4 = $3200
- Passive RFID Tags (6 units): $5 x 6 = $30
- Control Unit: $200
- Motion Sensors (PIR) (4 units): $50 x 4 = $200
- Contact Sensors (Door/Window) (4 units): $30 X 4 = $120
- Emergency Security Horn/Siren: $10
- Installation and Setup: $0
- Maintenance Fee (Yearly): $15 x 2 = $30
- Additional Sensors (Optional): $60 each x 4 = $240
- Basic Subscription Fee (24 months): $25/month x 24 = $600
- Premium Subscription Fee (24 months): $25/month x 24 = $600

Total Estimated Cost (Premium User) for 2 Years: $4030 + $1200
Sale Price: Net cost + 30% margin = $5299

These cost breakdowns are based on the specified components, subscription fees, and optional services outlined in the provided information. Actual costs may vary depending on specific requirements and any additional services or features chosen by the customer.

9. SUMMARY/CONCLUSION

The integration of IoT technology into our smart alarm system brings a new level of sophistication and functionality to home security. By leveraging IoT devices and connectivity, our system seamlessly integrates with the broader smart home ecosystem, allowing homeowners to monitor

and control their security settings remotely. Through the use of sensors, RFID technology, and cloud-based communication, our product offers real-time monitoring, intelligent alerts, and responsive actions in case of security breaches.

This level of integration means that homeowners can enjoy enhanced convenience and peace of mind. They can easily arm or disarm their alarm system, receive instant notifications on their smartphones, and even integrate security cameras or smart locks into the ecosystem. Our technology ensures robust encryption and authentication, guaranteeing the security and privacy of user data.

In essence, our smart alarm system embodies the convergence of IoT technology with traditional security systems, providing a comprehensive and user-friendly solution that meets the evolving needs of modern homeowners and businesses.

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