**2. DESIGN REQUIREMENT SPECIFICATIONS**

The Safe Paws is a health monitoring vest designed to ensure the well-being and safety of our pets. The vest is integrated with multiple sensors that detect/monitor the vital signs such as heart rate, body temperature, activity level, and respiratory rate. The user can monitor and control the system wirelessly through the Safe Paws application. The remote data monitoring can be viewed either live or historic. This section discusses the specific design requirements, technical and practical constraints, and engineering standards that drive the development of the Safe Paws pet monitoring vest.

**2.1. Requirements**

The specific design specifications, as listed in Figure 2-1 and Table 2-1, define the necessary requirements for Safe Paws. These requirements are met to ensure that the product satisfies the needs expected by customers but also adheres to the technical needs. This section discusses the marketing and engineering requirements. These requirements guide the development of our pet health monitoring solution.

**2.1.1. Marketing Specifications**

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**Figure 2-1: Object Tree for Safe Paws**

**2.1.2. Engineering Specifications**

**Table 2-1: Engineering Design Requirements**

|  |  |  |
| --- | --- | --- |
| **Marketing Requirements** | **Engineering Requirements** | **Justicifation** |
|  | Data Accuracy and Precision | To produce reliable vital signs data with error of ≥5% for all sensors. |
|  | Wireless Connectivity | To support wireless communication protocols, such as Bluetooth or Wi-Fi, in connectivity with the Safe Paws application. |
|  | Notification System | To send alerts to user’s application when pet is outside of safe health parameters. |
|  | Battery Life | To provide a minimum of 12 hours of continuous operation, with a low-battery warning sent to the user's device when the battery level falls below 20%. |
|  | Water and Dust Resistance (IP67) | To be rated at least IP67 for water and dust resistance to ensure durability and protection in various environments. |
| Marketing Requirements   1. The system should be at low cost. 2. The system should be durable. 3. The system should | | |

**2.2. Constraints**

This section defines the technical and practical constraints, as listed in Table 2-2. The constraints in the Safe Paws system include the production limits, durability to the typical behavior and environments of dogs, pet safety, battery life and size/weight considerations. The constraints guide the development of our pet health monitoring solution.

**Table 2-2: Constraints**

|  |  |  |
| --- | --- | --- |
| **Type** | **Name** | **Description** |
| Economic | Cost and Timeline Limits | Must not exceed budget of $1000 and the project timeline/ |
| Environmental | Durability | Must withstand typical dog environments and wear/tear. |
| Health and Safety | Pet Safety | Must not harm the dog wearing the vest. |
| Power and Performance | Battery Life | Must operate for a minimum of 12 hours on a single charge. |
| Manufacturability | Size and Weight | Must be designed for dogs weighing 50-90 pounds. |

**2.2.1. Economic Constraints**

Our project operates within a budget of $1000 and is constrained by the timeline of a single semester (fall semester). This means that design decisions, material choices, and development processes must align with the available financial resources and adhere to the project schedule.

**2.2.2. Environmental Constraints**

The Safe Paws vest must be designed to withstand the typical dog environments along with the wear and tear it may encounter during a dog's daily activities. This includes exposure to a degree of weather conditions, outdoor activities, and the potential for rough handling.

**2.2.3. Health and Safety Constraints**

The product must prioritize the safety and well-being of the pet wearing the vest. It should not cause any harm, discomfort, or stress to the dog. The resources used and overall design must be pet-friendly, ensuring that the dog can wear the vest comfortably.

**2.2.4. Power and Performance Constraints**

The vest's performance is constrained by the requirement to operate continuously for a minimum of 12 hours on a single battery charge. This constraint is critical to ensure that pet owners can rely on the device for extended monitoring periods without frequent recharging.

**2.2.5. Usability Constraints**

The vest's design centers on accommodating dogs weighing between 50 and 90 lbs. comfortably. This means that the vest must weigh roughly 5-9 lbs. It must strike a balance between size and weight to avoid hindering the dog's mobility and to ensure the vest is wearable without causing discomfort.

**2.3. Standards**

The Safe Paws health monitoring vest is a solution designed to ensure the well-being and safety of our pets. The vest is integrated with multiple sensors that detect/monitor the vital signs such as heart rate, body temperature, activity level, and respiratory rate. The user can monitor and control the system wirelessly through the Safe Paws application. The monitoring can be analyzed either live or historical. This section discusses the specific design requirements, technical and practical constraints, and engineering standards that drive the development of the Safe Paws pet monitoring vest.

**Table 2-3: Engineering Standards**

|  |  |  |
| --- | --- | --- |
| **Specific Standard** | **Standard Document** | **Specification / Application** |
| Public Law 89-544 | Animal Welfare Act | Relates to animal testing and welfare. |
| IEC 62368-1 | Safety of Audio, Video, and Similar Electronic Apparatus | Incorporates safeguards to prevent electrical hazards. |
| IP-67 | IEC standard 60529 | Dust-tight, immersion up to 1 m depth. |
| IEEE 802.11 | Wi-Fi connectivity | Relates to Wi-Fi connectivity for data transmission between vest and user’s application |
| ANSI/AAMI EC13-1992 | Cardiac Monitors, Heart Rate Meters, and Alarms | Heart rate monitoring accuracy and safety. |

**2.3.1. Animal Welfare and Ethical Testing Standards**

In alignment with ethical considerations and legal requirements, the testing standard includes protocols for conducting animal testing, if necessary. It ensures that any animal testing conducted adheres to the Animal Welfare Act, prioritizing the welfare and ethical treatment of animals involved in testing.

**2.3.2. Connectivity and Communications Standards**

To ensure seamless data transmission between the vest and the user's application, the testing standard includes procedures based on IEEE 802.11 standards. It evaluates the reliability, security, and compatibility of the vest's Wi-Fi connectivity, verifying that it meets industry best practices.

**2.3.3. Safety Standards**

Safety is paramount when it comes to electronic devices. To achieve this, we incorporate safety measures and tests that draw from IEC 62368-1 standards. Our testing evaluates the vest's electronic components for full compliance with safety requirements, effectively mitigating electrical risks. This ensures that the vest is not only reliable but also safe for both pets and their owners.