2. DESIGN REQUIREMENT SPECIFICATIONS

AlertSense is an alarm system with advanced security and safety features that alert the user if someone is attempting to break into the user's house or if there is a fire present. The device is primarily for people with hearing impairments or sensory impairments but can also be utilized by people who have trouble awakening. AlertSense aims to solve safety risks that could arise during the night.

2.1 Requirements

AlertSense is a system that utilizes carbon monoxide and door sensors to alert a user during the night in cases of danger. With AlertSense being primarily a safety device, a high level of standards is necessary to ensure the safety of its users. Hence, the following section outlines the requirements needed to ensure the best and safest experience for the user.

2.1.1 Marketing Requirements

The marketing requirements for AlertSense are as follows:

1. AlertSense detects an intruder.
2. AlertSense detects a fire.
3. AlertSense shines a light in the user's face to ensure that the user awakens.
4. AlertSense vibrates the user's bed without causing damage to the bed frame.
5. AlertSense connects to the user's smartphone to set alarms.
6. AlertSense allows the user to disable the alarm in cases of a false alarm.
7. AlertSense wakes a user in the case that they are a heavy sleeper.
8. AlertSense has a simple setup for all users.

Figure 2-1 gives a layout of all the marketing requirements for Alert Sense. AlertSense has three main branches which include safety, user-friendliness, and versatility. From these three branches, AlertSense has several measures in place to uphold those three main values.
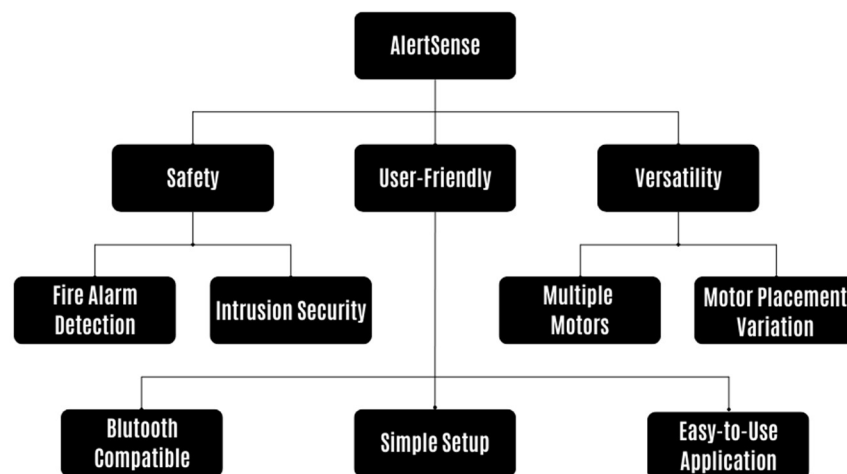

Figure 1.1: Objective Tree for AlertSense

Hence, the objective tree in 2.1 gives a broad overview of the many different marketing requirements stated above. The figure also showcases how AlertSense handles those requirements and upholds the values and standards of safety, user-friendliness, and versatility.

2.1.2 Engineering Requirements

Table 2.1 outlines the major requirements associated with AlertSense. These requirements specify technical details regarding AlertSense's safety and ease-of-use features. AlertSense meets all these requirements to ensure its users are satisfied with usability and safety.

Table 1.1: Engineering Design Requirements

Marketing Requirements	Engineering Requirements	Justification
1	The door sensor can detect changes in the magnetic field in less than 1 second.	Magnetic sensors must send a message to the receiver instantaneously to alert the user of danger [2].
2	Carbon monoxide sensors detect heavy concentrations of carbon monoxide in the air in parts per million in less than 1 second.	Carbon monoxide sensors must instantaneously identify specific particles signaling a fire [3].
3, 5, 8	AlertSense can output from 50 watts up to 100 watts.	This power range displays both the minimum and maximum amount of wattage required to sustain the motors for vibration [1].
3, 4, 5, 8	AlertSense can output a low of 4 volts to a high of 10 volts.	This is the voltage needed to power the dimming light and move the frame at different intensity levels [1].
6, 7, 9	AlertSense consists of 2 processors that are Bluetooth compatible.	Bluetooth allows the user to easily access the AlertSense application [7].

AlertSense detects changes in the magnetic field in less than one second. This guarantees that the door sensor triggers almost instantaneously so that the device can send a signal to the control module to ensure maximum safety.

AlertSense detects carbon monoxide in the air in parts per million in under one second. This is to certify that in the case of a fire in the home, the user is alerted immediately to the safety hazard and can escape the building unharmed.

AlertSense outputs from 50 watts to 100 watts of power. AlertSense can also only output a low of 4 volts to a high of 10 volts. These measurements ensure that the vibration is not too robust that damage is caused to the bed frame or the user, while also certifying that the vibration is not so weak the motors are ineffective.

AlertSense consists of a processor that is Bluetooth-compatible. This guarantees that any user with a smart device can access the AlertSense app and control the alarm system via their device.

2.2 Constraints

Table 2.2 outlines the major constraints associated with AlertSense. AlertSense remains a device that ensures the safety of its users while limiting itself to the listed constraints.

Table 2.2: Constraints

Type	Name	Description
Economic	Cost	AlertSense has a cost constraint of $1000 allotted by the electrical and computer engineering department.
Adaptability	Versatility	The AlertSense system has four motors located on each of the four corners of the bed to ensure versatility regardless of the size of the bed.
Manufacturability	Size	The physical dimensions are 6" high, 9" wide, and 9" deep.
Health and Safety	Reliability	AlertSense has a built-in battery pack to ensure that in the case of a power outage, safety systems are still operational.
Health and Safety	Electrical Safety	AlertSense has an enclosure that protects all the wiring for the system. This enclosure ensures maximum protection of the user from possible hazards [4].
Sustainability	Functionality	The four motors included with the AlertSense system are placed between two fitted sheets. The sheets allow for vibrational absorption to avoid bed frame damage.

2.2.1 Economic Constraints

AlertSense does not exceed a total cost of $1000. This amount is provided by the electrical and computer engineering department. The product is also cost-effective for the user.

2.2.2 Adaptability

The AlertSense system is compatible with multiple bed sizes and types. Due to this constraint, the AlertSense system features four motors on each of the bed's four corners. The location of each motor guarantees versatility and allows for proper vibrational levels for all bed types.

2.2.3 Manufacturability

The dimensions of the control module are 6" high, 9" wide, and 9" deep. These dimensions ensure that it does not take up too much space on the bed while still having adequate space for components.

2.2.4 Health and Safety

Due to AlertSense being used to ensure the safety of people with hearing impairments, the system does not falter in the case of a power outage. To ensure that this constraint is met, AlertSense features a battery pack that activates if the main power source fails.

AlertSense has several motors and wires that could result in hazardous conditions for the user if not kept enclosed. To ensure maximum safety for the user, AlertSense features an enclosure that protects the user from any wire faults or other hazardous materials [4].

2.2.5 Sustainability

AlertSense features several motors that have the potential to damage bed frames. To ensure that AlertSense does not cause any damage, AlertSense features padding around the motors. The motors are also located between two fitted sheets which allows for the system to vibrate the bed while also leaving the frame intact.

2.3 Standards

Table 2.3 outlines the major standards associated with AlertSense. AlertSense complies with all major standards set forth by IEEE, the National Fire Protection Association, Bluetooth, and the FCC.

Table 2.3: Engineering Standards

Specific Standard	Standard Document	Specification/Application
Insulation	The National Fire Protection Association 70 Articles 240 and 300.	The plastic enclosure prevents shock or electrocution of the user [4].
Bluetooth 5.2	Bluetooth Core Specification Version 5.2	Bluetooth ensures easy connectivity with a user's smartphone [7].
Software and System Testing	IEEE Standard for Software and System Test Documentation 829-2008	This practice is standard for testing the hardware and software of products [5].
FCC Section 15.109	Class B Digital Devices	This standard helps to avoid interference from other devices within 10 meters of the system [6].

2.3.1 Testing Standards

AlertSense follows IEEE standards for software and system testing. These standards ensure the system is up to code and runs properly.

2.3.2 Communications Standards

AlertSense uses Bluetooth version 5.2 for communication between a tablet or smartphone to the control module. This version of Bluetooth uses standards from the Bluetooth Core Specification Version 5.2 documentation [7].

2.3.3 Electrical Standards

AlertSense uses standards for overcurrent and wiring from NFPA 70, Articles 240, and 300. By following the standards brought forth in these articles, AlertSense meets all standards for shock absorption and fire hazards [4].

AlertSense use is generally within residential areas, which warrants the need for interference prevention from signals or other digital devices. Hence, AlertSense utilizes standards from FCC Section 15.109 for digital device interference [6].

Citation

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