Design Requirement Specifications

2.1 Requirements

2.1.1 Marketing Requirements

The marketing requirements are as follows:

1. Gestura controls smart home devices with gestures.
2. Gestura is easy to set up.
3. Gestura is accurate up to at least 10 feet.
4. Gestura is compatible with most smart home devices.
5. Gestura is suitable in any home environment.
6. Gestura provides user feedback on if a gesture is recognized or not recognized.
7. Gestura minimizes the chance of unintentional triggers

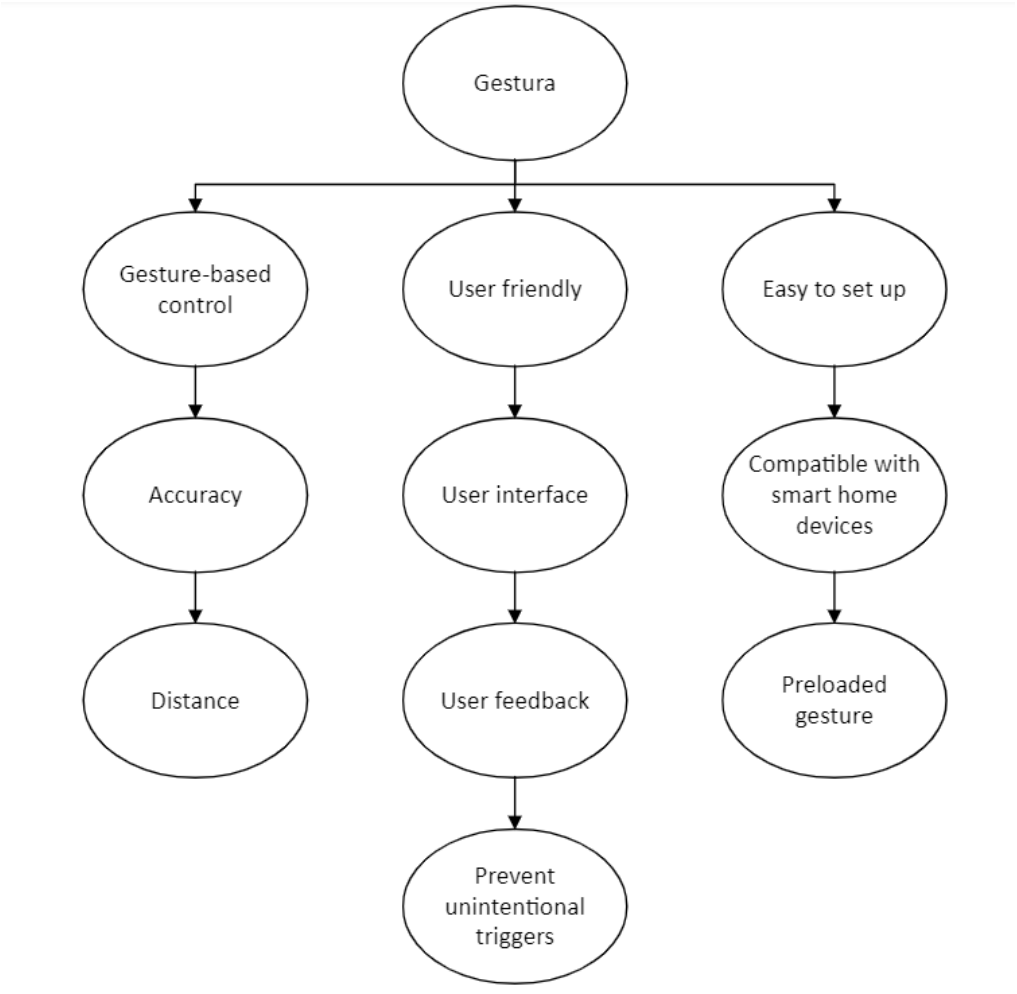

Figure 2-1. Object Tree for Gestura: Gesture-based Smart Home

2.1.2 Engineering Requirements

Table 21: Engineering Design Requirements

Marketing Requirements	Engineering Requirements	Justification
1,3,6,7	The camera must be at least 8 MP.	To be able to pick up a hand at 10+ ft the video needs to be high quality.
2,5	USB-C powered at 5v dc with ≥ 3 amps (15 watts or greater).	The Raspberry PI needs a USB-C with 5 watts of power, and it is not complicated to plug in.
2,4	The device must take less than 5 minutes to power and connect to Wi-Fi.	Competitors demonstrate that 5 minutes to set up is a reasonable time.
1,2,4,6	The device must be Bluetooth and Wi-Fi compatible to control the main brands of smart homes.	Most smart home devices connect through Bluetooth to set up on a home Wi-Fi network.
5	The Raspberry PI 4 Model B must have a fan to keep temperatures below 45° Celsius.	This ensures the device will not overheat and crash.
2,5	The dimensions of the Raspberry PI should be less than 5in x 4in x 4in	The device does not need to be too bulky. This will make sure that it is easy to set up and place

Marketing Requirements

1. Gestura controls smart home devices with gestures.
2. Gestura is easy to set up.
3. Gestura is accurate up to at least 10 feet.
4. Gestura is compatible with most smart home devices.
5. Gestura is suitable in any home environment.
6. Gestura provides user feedback on if a gesture is recognized or not recognized.
7. Gestura minimizes the chance of misinput from unintentional activation.

The Requirements

The team's engineering requirements prioritize ensuring ease of use and reliability. This device should run smoothly and should not be too hard to connect to other devices (lights, thermostats, TVs, etc.).

Camera Requirements

With an 8 MP camera, the gesture tracking will be clear enough to detect hand signs. As the team test our gesture tracking software, we may have to improve the camera quality for us to reach our goal of at least 10 ft.

Power Requirements

The Raspberry PI specifies that it needs 5v DC with at least 3 amps. The specifications for the device further elaborate that a good 2.5A power supply may be used if the cable does not draw over 500mA. For reliability purposes, we will ensure our power supply is at least 3 Amps. This ensures the device will be able to run without being underpowered.

Device Requirements

The Raspberry PI 4 Model B is a subcompact computer. The device is a circuit board with the bare minimum. The device can overheat and does not come with a case. Trying to make the device more reliable,

we are going to install a fan to keep the device below 45° Celsius. Also, we are going to 3D print a case to protect the delicate hardware components.
Most Smart home devices pair via Bluetooth or Wi-Fi (hotspot) to connect to a home network. Our device has 2.4GHz, 5.0Ghz, and Bluetooth 5.0 Compatibility. This will increase the devices that can connect to our product.

2.2 Constraints

The constraints are the basis of the product. They will outline the requirements the device will need to meet. These constraints include hardware, communication, accuracy, economics, and reliability. The hardware includes the control module and all other exterior components for the device including the power supply, assembling, and the size of the container. The communication constraints primarily refer to how the device will communicate with the cameras and how the data will be stored. Accuracy refers to how well the device will need to operate. Economics is the financial side of the product. The device should be affordable for homeowners. Lastly, reliability is the required maintenance and the anticipated life span of the device. The product should meet all the constraints below.

Table 22: Constraints

Type	**Name**	**Description**
Hardware	Raspberry Pie 4 Power Set up Size	Control module USB C-port Easy Set up 6”x6” container
Communication	Bluetooth WIFI	Connection with other devices via Bluetooth Communicate with cameras and smart home devices
Accuracy	Distance Unintentional Triggers Parental Controls	Accurate with in 10 feet Prevent misinterpreted gestures Safety for children
Economics	Price	Affordable and profit
Reliability	Maintenance	Minimum maintenance

2.2.1 Hardware

Raspberry PI 4 Model B

The Raspberry Pie 4 will be used as the control module. It is affordable, compact, USB powered, and easily programmed. To ensure a small and compact device, opting for the Raspberry Pi is an excellent decision. A USB Type-C port will be used to plug the device into a power source. The Raspberry Pi is known for its ease of programmability, thanks to its user-friendly interface and abundant community support.

USB Type-C port for power

The USB Type-C port has gained popularity as the preferred choice for powering and charging electronic devices, driven by both its versatility and the increasing demands of the technological world. USB-C cables are becoming universal for many devices including Apple and Samsung smartphones, tablets, cameras, and many more electronic devices. Using a C-port cable to power the device is ideal as it eliminates the inconvenience of dealing with multiple cables. Furthermore, the reversible design of the C-port cable eliminates the risk of damage caused by inserting the cable incorrectly.

Easy set up

Simplicity in the setup process is crucial, as it aligns with customer preferences for an uncomplicated installation experience. This device will feature a "plug and play" method. This simplified setup not only enhances user-friendliness but also saves time and reduces the likelihood of errors. This user-friendly product is expected to boost sales and make it easier for people with minimal extra time or people with difficulties handling electronic devices.

Size

The size of the device will be no larger than a 6”x6” enclosed structure. The device should be portable and placed anywhere in the home where power is available.

2.2.2 Communication

Bluetooth

Bluetooth communication is needed because the device is wireless. Having a Bluetooth connection eliminates the hassle of having extra wires that connect to the control module. The device, cameras, and other smart home accessories will have Bluetooth capabilities. Bluetooth serves as the primary means for short-range communication, and the device will be strategically positioned within range of most other connected devices.

WIFI

Wi-Fi will be used to communicate with cameras and other devices inside the home. Devices that connect through Wi-Fi will be used which will eliminate the need for wiring and short Bluetooth range. The system will connect to existing home Wi-Fi networks.

2.2.3 Accuracy

Accuracy Distance

The cameras used for the device will have a high resolution to track gestures. The team decided that 10 ft or more will be best suited for average-sized rooms. This ensures that the user can perform gestures within most of the room where a camera is positioned.

Prevent Unintentional Triggers

Recognizing the correct gestures is a key feature of the device. It must distinguish a gesture from any other hand movements. Also, the device requires the capability to precisely identify and differentiate similar gestures.

Parental Controls

Parental controls are paramount for the safety and effectiveness of the device. They add the ability for parents to ensure that children do not have control of the device. Having parental control prevents unintentional tasks.

2.2.4 Economics

Price

The price needs to be affordable for the consumers. The team is working to make the device available competitively at an estimated price of $250, considering the time to build the product and the cost of parts. The cameras, power supply, and case are included in the price.

2.2.5 Reliability

Maintenance

The device is designed to be minimal maintenance, needing as little maintenance as a phone or other smart home devices. Cameras will need periodic battery replacement/charging to maintain power. Dusting or wiping down may be required depending on the environment where the system is set up.

2.3 Standards

The team will ensure that the standards below are followed for this project's future. The standards will protect the consumer and help the product run more reliably. As these applications are tested, the team will make sure to meet or exceed these standards. During the test phase, if a certain standard is not met, the team will update the components to meet or exceed the criteria.

Table 23: Engineering Standards

Specific Standard	Standard document	Specification / application
USB 3.0	Universal Serial Bus Revision 3.0 specification	Connectivity with the Raspberry Pi 4.
Bluetooth 5.0	Bluetooth Core Specification Version 5.0	Wireless connectivity with the Raspberry Pi 4.
802.11ac wireless	IEEE standard for WIFI	2.4 GHz and 5.0 GHz compatibility.
2802	UL	Standard for performance testing of camera image quality.
29119-3	ISO/IEC/IEEE	Software test documentation standard for software testing.

2.3.1 Testing Standards

To test the performance of the camera image quality, we will be testing the image quality of the camera as stated in the UL 2802 standard. The camera will take a quick snapshot of hand gestures. To determine success will be if the Raspberry Pi being able to recognize the hand gesture clearly.

2.3.2 Communications Standards

The Raspberry Pi 4 will be connected to cameras and other smart home devices using the Universal Serial Bus and Bluetooth Core Specification standards.

2.3.3 Documentation Standards

For documentation, we will be following the ISO/IEC/IEEE 29119-3 standard. We will be keeping documentation of the testing process for both software and image quality test of the camera. Main documentation that will be taken is organizational, management, and dynamic test processes. The organizational test process will be documentation of our strategy in testing our product. The test management process will focus on the plan for the test, the status of the test and whether it is completed. The dynamic test process will be documentation of what we are testing and what factors could affect our product and testing it in those different scenarios and environments.