PET ROBOT

ROHIT RADHAKRISHNAN (20233550)

PET ROBOT

IDENTIFYING CUSTOMER NEEDS (EXHIBIT 5-6)

CUSTOMER: VISHWA RAVINDREN.

ADDRESS: Room Number (618) SVBH MNNIT PRAYAGRAJ.

PHONE NUMBER: +91 8056883***.

EMAIL: vishwaravindren@gmail.com

Willing to do follow-up? Yes.

INTERVIEWER: Rohit Radhakrishnan.

DATE: 21/3/2024.

TYPE OF USER: STUDENT.

PET ROBOT

Question/Prompt	Customer Statement	Interpreted Need
Can you tell me about your experience with pets or robots in the past?	I've had pets in the past, but never a robot. However, I'm fascinated by the idea of having a pet-like companion with robotic features.	Companionship and Entertainment.
How important is it for the robot to avoid obstacles in its environment?	Obstacle avoidance is crucial for ensuring the safety of the robot and preventing any potential accidents or damage to the surroundings.	Safety and Convenience.
Do you prefer a specific type or frequency of beep sounds for communication with the robot?	I prefer beep sounds that are not too loud or jarring, but still audible enough to get my attention when necessary.	Sound Effects.
What expectations do you have regarding the robot's walking capabilities?	I expect the robot to have stable and smooth walking capabilities, similar to a pet's movement, to enhance its lifelike qualities.	Stability in Walking.

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How significant is the ability for the robot to dance to you?	The ability for the robot to dance adds a fun and entertaining element to its features, which I would enjoy.	ABILITY (DANCE).
In what ways do you envision using the robot's programmable features?	I envision using the programmable features to customize the robot's behaviors, such as setting routines or teaching it new tricks.	DYNAMIC PROGRAMMING.
How do you feel about the modularity of the robot, where components can be added or removed as needed?	I appreciate the idea of a modular robot, as it provides flexibility for upgrading or customizing its features according to my changing needs or preferences.	MODULAR PET ROBOT.

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Would you like the option to fully dismantle the robot for maintenance or customization purposes?	Having the option to fully dismantle the robot for maintenance or customization purposes would be beneficial, as it ensures easier access to its components when needed.	DISMANTABILITY.
Can you speak to the design considerations regarding the ergonomics and durability of our pet robot?	Certainly. When conceptualizing the pet robot, we placed a strong emphasis on both ergonomics and durability to ensure optimal user experience and longevity of the product.	ERGONOMICS, ROBUST PERFORMANCE.

PET ROBOT

IDENTIFYING LATENT NEEDS

LATENT NEEDS	REQUIREMENT
Customizability and Personalization.	• Customers may desire the ability to customize the appearance or behavior of the pet robot to better suit their preferences or personality. • Offering options for interchangeable parts, colors, or accessories can fulfill this latent need for personalization.
Simplified Maintenance and Repair.	• While dismantlability is a stated feature,

PET ROBOT

	customers may also value simplicity in maintenance and repair tasks. • Providing easy-to-follow guides, toolkits, or online resources for troubleshooting and repairs can address this latent need for hassle-free maintenance.
Adaptability to Different Environments.	• Customers may want the pet robot to perform reliably in various settings, including indoors, outdoors, or in different lighting conditions.

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	• Incorporating robust obstacle avoidance sensors that can handle diverse environments, such as both IR and ultrasonic sensors, can satisfy this latent need for adaptability.
Integration with Smart Home Systems.	• Customers may seek compatibility with existing smart home ecosystems, allowing them to control the pet robot alongside other connected devices. • Integrating the dynamic programming port with common smart home protocols (e.g.,Z-Wave, Wi-Fi) can fulfill this latent

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	need for seamless integration.
Inclusive Design for Users with Disabilities.	• Consideration for users with disabilities or impairments who may benefit from features like tactile feedback, audible cues, or voice control. • Providing accessibility options, such as voice commands, large buttons, or tactile indicators, can fulfill this latent need for inclusive design.
Energy Efficiency and Sustainability.	• Customers may value energy-efficient operation and

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	sustainable design practices. • Incorporating energy-saving features, such as low-power modes or eco-friendly materials, can address this latent need for environmental responsibility.

MISSION STATEMENT (EXHIBIT 5-3)

PET ROBOT

MISSION STATEMENT: PET ROBOT PROJECT
PRODUCT DESCRIPTION: Pet Robot for Entertainment and Companionship.
BENEFIT PROPOSITION: Flexibility and Upgradability.
PRIMARY MARKET: Children and Older Adults.
SECONDARY MARKET: Pet Owners, Families with Busy Lifestyles, Educational Institutions.
Assumptions: Desire for Customizable and Modular Products.
STAKEHOLDERS: •User • Retailer • Sales force • Service center • Production • Legal department

PET ROBOT

IMPORTANCE WEIGHTINGS

PRODUCT

CUSTOMER NEED	PREFERENCE (5)
1) Safety and Convenience.	5
2) Sound Effects	3
3) Stability in Walking	4
4) ABILITY (DANCE)	4
5) DYNAMIC PROGRAMMING	5
6) MODULAR PET ROBOT	5
7) REASONABLE PRICE	3
8) DISMANTABILITY	4
9) ERGONOMICS	4

PET ROBOT

10) ROBUST PERFORMANCE	4

ESTABLISHING TARGET SPECIFICATIONS (EXHIBIT 6-8)

METRIC NO	NEED NOS	METRIC	IMPORTANCE	UNITS
1	3,6	Accuracy of Ultrasonic Sensor.	4	mm
2	3,7	Response Time of Ultrasonic Sensor.	4	ms (milli seconds)
3	4,6	Battery Life.	4	mAh
4	3	Charging Time.	3	Hours(h)
5	9	Reliability of on/Off Switch.	5	Percentage (%)
6	4,9	Arduino Nano Processor Utilization.	5	Percentage (%)
7	1,4,6	Servo Motor Performance.	4	Torque (oz-in)
8	4,6,9	Sound Quality and Effectiveness.	3	dB
9	4,6	Input-Output Shield Integration.	4	Bits per second (bps)
10	11,6	Modularity.	5	No of parts.

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11	**10,6,9**	Dismantlability.	3	Percentage (%)
12	**3,6,7,9**	Dynamic Programming Efficiency.	5	(YES/NO)

COMPETITIVE BENCHMARKING (EXHIBIT 6-6)

Feature	Pet Robot	Emo Desktop Pet	Eilik Robo Pet.	Ergo-Dura Pet Bot
Accuracy of Ultrasonic Sensor.	30mm	20mm	25mm	19mm
Response Time of Ultrasonic Sensor.	8ms	8ms	6ms	7ms
Battery Life.	900mAh	800mAh	800mAh	600mAh
Charging Time.	2h	1.5h	1.5h	1.25h
Reliability of on/Off Switch.	99%	90%	85%	85%
Arduino Nano Processor Utilization.	45%	47%	40%	42%
Servo Motor Performance.	20 (oz-in)	15 (oz-in)	13 (oz-in)	17 (oz-in)
Sound Quality and Effectiveness.	90dB	83dB	75dB	70dB
Input-Output Shield Integration.	300bps	275bps	280bps	290bps
Modularity.	16(NOP)	14(NOP)	15(NOP)	13(NOP)
Dismantlability.	98%	95%	94%	91%

PET ROBOT

Feature	Pet Robot	Emo Desktop Pet	Eilik Robo Pet.	Ergo-Dura Pet Bot
PRICE.	Competitive	HIGHER	LOWER	HIGHER
Dynamic Programming Efficiency.	YES	NO	NO	YES

COMPONENT LIST (EXHIBIT 6-10)

COMPONENT	Qty/Fork	High (₹ea.)	Low (₹ea.)	Low Total(₹/Fork)	High Total(₹/Fork)
Nano ATmega328	1	319	245	245	319
Nano Shield I/O	1	182	82	82	182
Mini USB cable	1	50	28	28	50
Ultrasonic sensor HC-SR04	1	60	50	50	60
Mini servo SG90 9g(Each one should come with 2 M2 pointed screws and one small screw)	4	85	75	300	340
5V Buzzer	1	20	10	10	20
Dupont F/F cable connectors 10cm	6	40	30	30	40
4 AA Battery case stacked with switch soldered	1	60	41	41	60
AA alkaline batteries (1.5V each)	4	10	11.25	45	50
Mini cross screwdriver	1	300	250	250	300
Cello Tape	3	15	10	30	45
Double Side Tape	2	15	10	20	30

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Scissor	1	45	35	35	45
Wire Cutter	1	60	50	50	60
Hot Glue Gun	1	300	150	150	300
Soldering Iron Kit	1	350	250	250	350
Glue Sticks	7	7	5	35	49
TOTAL	37			1651	2300

TECHNICAL SPECIFICATIONS (EXHIBIT 6-8)

S No.	FEATURES	UNITS	VA
1	Accuracy of Ultrasonic Sensor.	mm	30
2	Response Time of Ultrasonic Sensor.	ms (milli seconds)	8
3	Battery Life.	mAh	900
4	Charging Time.	Hours(h)	2
5	Reliability of on/Off Switch.	Percentage (%)	9
6	Arduino Nano Processor Utilization.	Percentage (%)	4
7	Servo Motor Performance.	Torque (oz-in)	20
8	Sound Quality and Effectiveness.	dB	90
9	Input-Output Shield Integration.	Bits per second (bps)	300
10	Modularity.	No of parts.	16
11	Dismantlability.	Percentage (%)	9
12	Dynamic Programming Efficiency.	(YES/NO)	Y
13	LEFT FOOT.	mm	30mm
14	RIGHT FOOT.	mm	30mm

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15	TARSAL JOINT.	mm	15mm
16	DISTAL SEGMENT (RIGHT/LEFT).	mm	35mm
17	FORELIMB (RIGHT/LEFT).	mm	35mm
18	PERCEPTION UNIT.	mm	45mm x 35
19	Sensor Port Diameter.	mm	8.4
20	Fill Thickness.	mm	2

FEATURES	UNITS	MARGINAL VALUES	IDEAL VALUES
Accuracy of Ultrasonic Sensor.	mm	10-30	10-40
Response Time of Ultrasonic Sensor.	ms (milli seconds)	10-100	5-75
Battery Life.	mAh	4000-6500	1500-3000
Charging Time.	Hours(h)	3-6	4-5
Reliability of on/Off Switch.	Percentage (%)	90-95	85-95
Arduino Nano Processor Utilization.	Percentage (%)	30-80	10-50
Servo Motor Performance.	Torque (oz-in)	80-90	30-200
Sound Quality and Effectiveness.	dB	60-90	70-100
Input-Output Shield Integration.	Bits per second (bps)	100-350	150-400
Modularity.	No of parts	Configurable	Configurable
Dismantlability.	Percentage (%)	50-90	20-99
Dynamic Programming Efficiency.	(YES/NO)	Configurable	Configurable
LEFT FOOT.	mm	35mmx15mm (LESSER)	40mmx20mm (LESSER)

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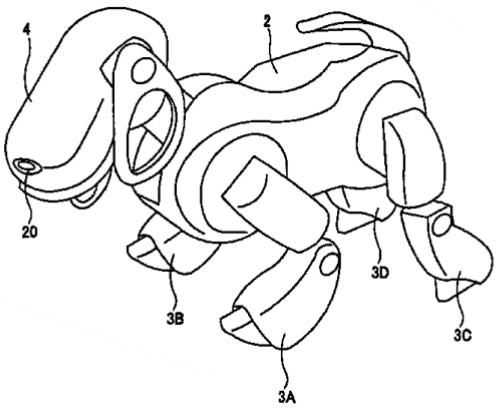
RIGHT FOOT.	mm	35mmx15mm (LESSER)	35mmx15mm (LESSER)
TARSAL JOINT.	mm	25mmx15mm	30mmx15mm
DISTAL SEGMENT (RIGHT/LEFT).	mm	30mmx25mm (LESSER)	25mmx20mm (LESSER)
FORELIMB (RIGHT/LEFT).	mm	30mmx25mm (LESSER)	25mmx20mm (LESSER)
PERCEPTION UNIT.	mm	45mmx45mm	50mmx50mm
Sensor Port Diameter.	mm	8-9	8-10
Fill Thickness.	mm	2-3	1-3

CONCEPT GENERATION

PATENT SEARCH

1) FOUR-LEGGED MOBILE ROBOT



PET ROBOT

DESCRIPTION

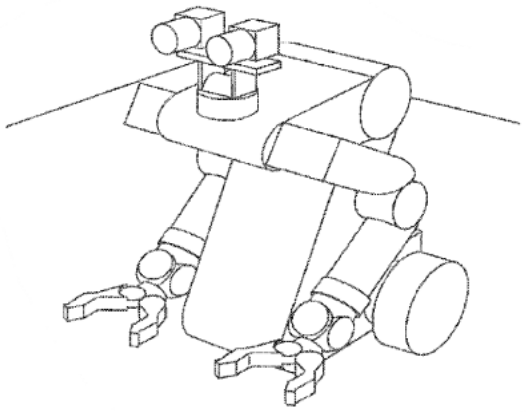
For a four-legged mobile robot, the term "quadruped robot" is commonly used. These robots typically have four legs, each equipped with actuators for movement, and they often mimic the locomotion of animals such as quadrupeds (animals with four legs). Quadruped robots can exhibit various types of locomotion, including walking, trotting, bounding, and even climbing over obstacles. They are used in a variety of applications, including research, exploration, surveillance, and assistance in rough terrain or environments where wheeled or tracked robots may struggle to navigate effectively.

LINK

https://patents.google.com/patent/US7062356B2/en?q=(pet+robot)&oq=pet+robot

PET ROBOT

2) OBJECT POSITIONING ROBOT



DESCRIPTION

A robot designed to detect objects and determine their positions is often referred to as an "object

PET ROBOT

detection and localization robot" or simply an "object positioning robot." These robots typically use various sensors and techniques to identify the presence of objects in their surroundings and determine their relative positions.

Some common sensors used for object detection and localization include:

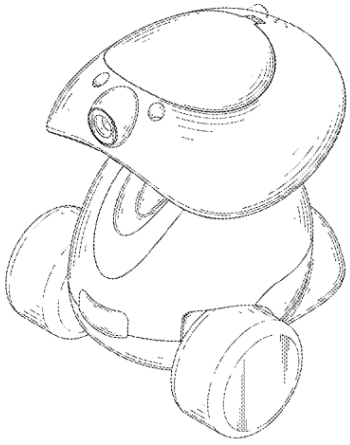
i. Ultrasonic Sensors.
ii. Infrared (IR) Sensors.
iii. Camera Systems.
iv. LiDAR (Light Detection and Ranging).

LINK

https://patents.google.com/patent/US11345041B2/en?q=(pet+robot)&oq=pet+robot&page=4

3) **PET ROBOT (DESIGN)**

PET ROBOT

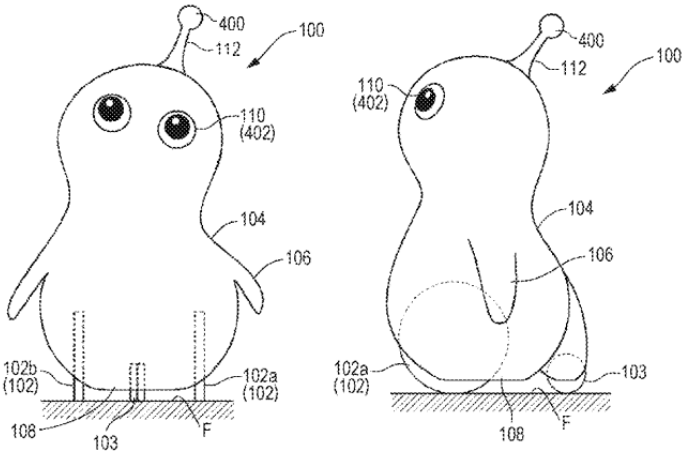


LINK

https://patents.google.com/patent/USD837854S1/en?q=(petrobot)&oq=petrobot

4) ACTING ROBOT

PET ROBOT



DESCRIPTION

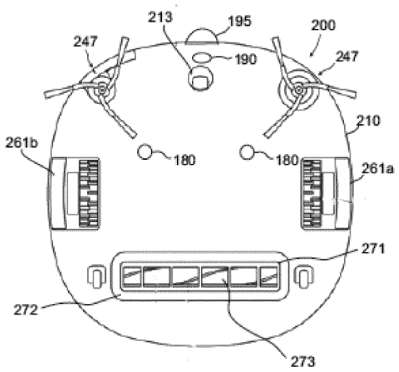
Acting robots are robots designed to perform tasks or actions that mimic human-like movements or behaviors. These robots are often used in entertainment, performance art, education, and research.

LINK

https://patents.google.com/patent/US11148294B2/en?q=(pet+robot)&oq=pet+robot&page=1

PET ROBOT

5) CLEANING ROBOT



DESCRIPTION

A cleaning robot, also known as a robot vacuum cleaner or robotic vacuum, is an autonomous robotic device designed to clean floors, carpets, and other surfaces without human intervention. These robots are equipped with sensors, motors, and cleaning mechanisms to navigate around obstacles and effectively remove dirt, dust, and debris from various floor types.

LINK

PET ROBOT

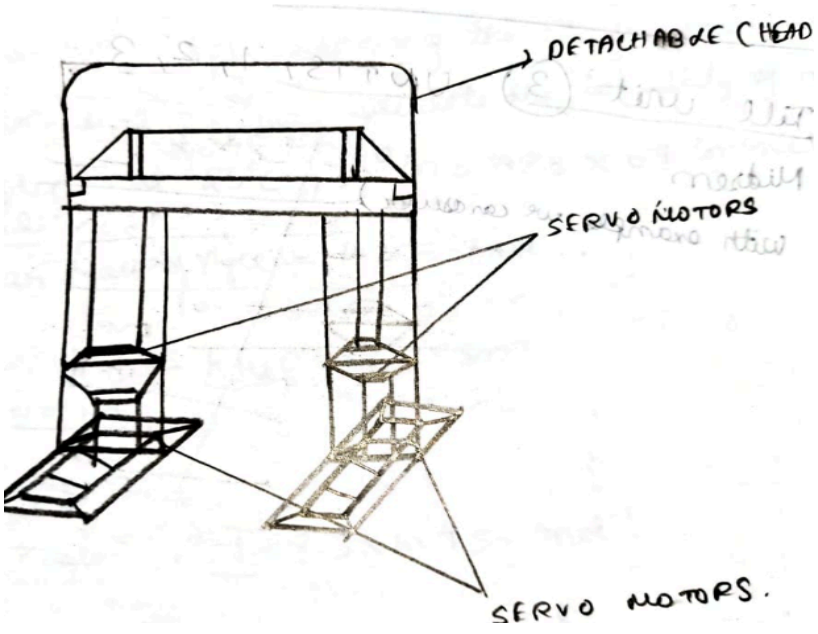
https://patents.google.com/patent/EP3679849B1/en?q=(pet+robot)&oq=pet+robot&page=3

SEARCH INTERNALLY

SHASHI RANJAN, RITESH, ABDUL KALAM:

PATENT SEARCH, DECOMPOSITION BY SEQUENCE OF USER ACTIONS.

1) CONCEPT DESIGN-1:



PET ROBOT

DESCRIPTION

This concept it does not include an ultrasonic sensor for obstacle avoidance, lacks an external on/off switch (requiring users to open its head to turn it on or off), and does not offer a dynamic programming port for customization.

This design choice appears to prioritize simplicity and perhaps cost reduction over user convenience and flexibility. By omitting the ultrasonic sensor, the robot may rely on other methods or rely on user intervention to navigate around obstacles.

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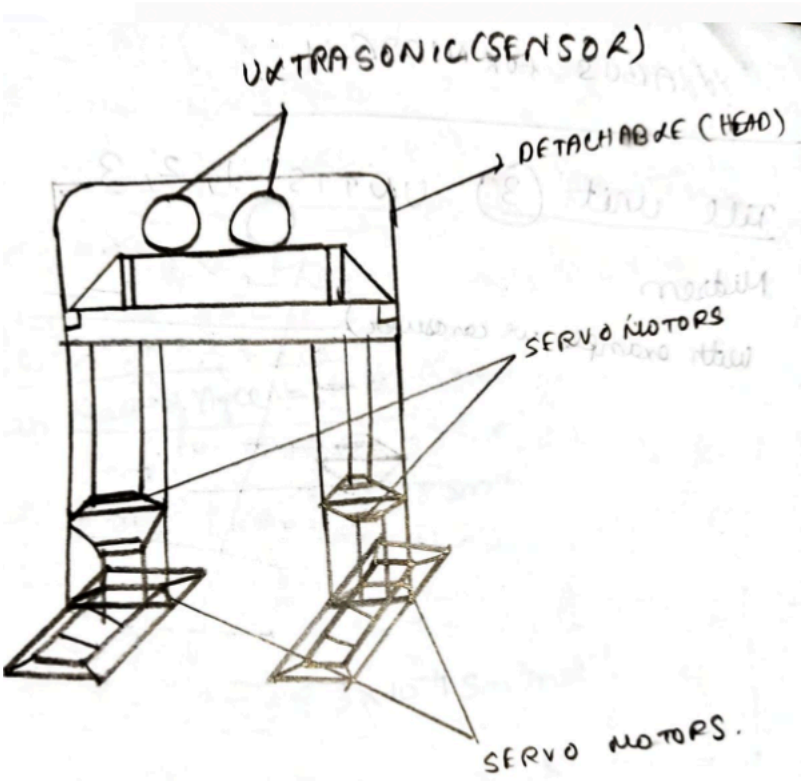
2) CONCEPT DESIGN-2:



DESCRIPTION

The concept described involves a pet robot designed with specific characteristics that impact user convenience and interaction. This robot features an ultrasonic sensor for obstacle avoidance, implying that it can navigate its environment without colliding with objects. However, it lacks

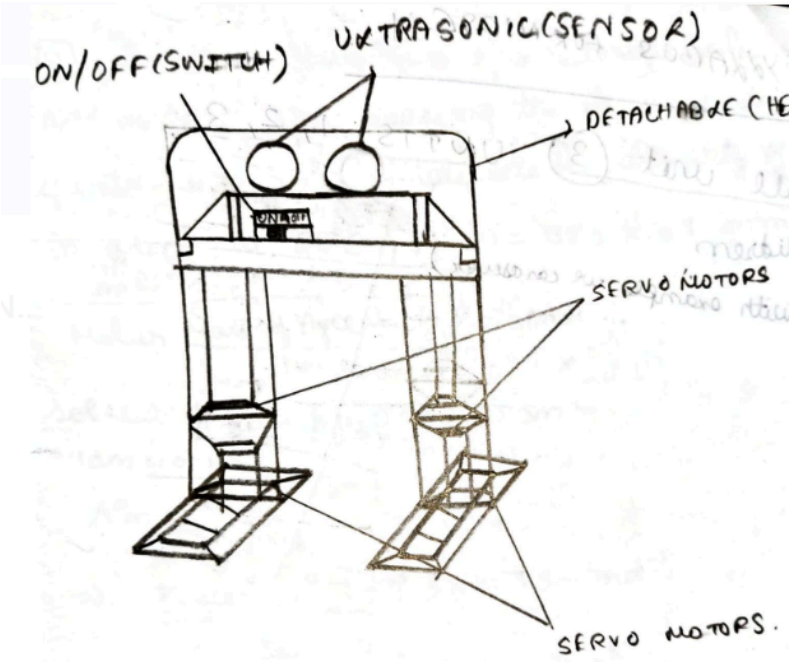
PET ROBOT

an external on/off switch, requiring users to physically open its head to power it on or off.

This design choice presents several implications. Firstly, by integrating the ultrasonic sensor, the robot demonstrates autonomous behavior, enhancing its ability to move around and interact with its surroundings without constant user intervention. However, the absence of an external on/off switch diminishes user convenience and accessibility.

3) CONCEPT DESIGN-3:

PET ROBOT



DESCRIPTION

A pet robot equipped with an ultrasonic sensor for obstacle avoidance and an external on/off switch, but lacking a dynamic programming port, is designed to provide interactive and autonomous behavior within predefined parameters.

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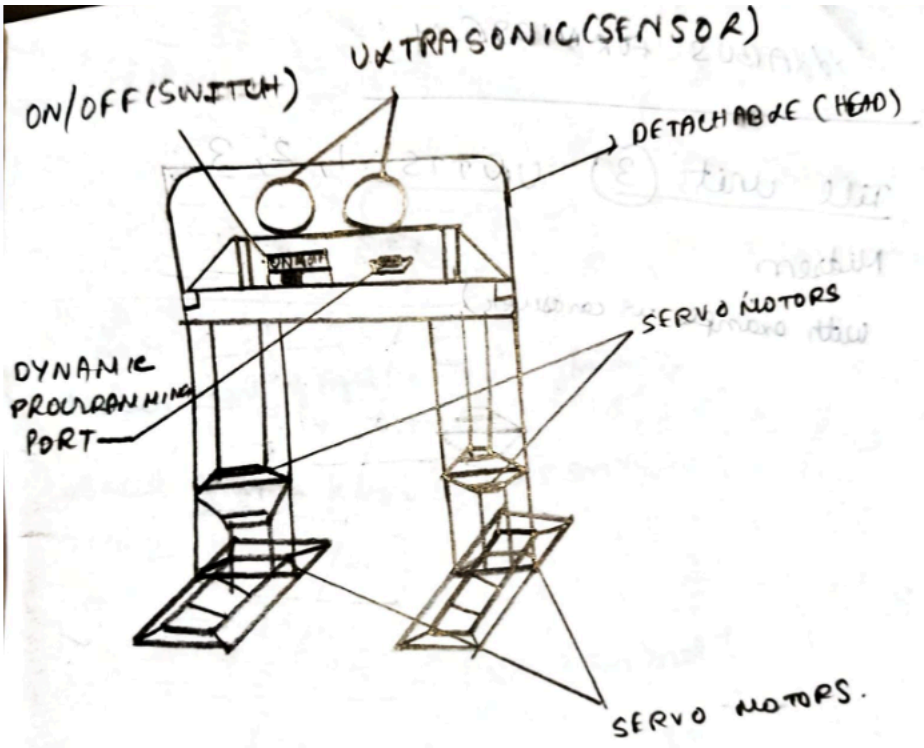
The external on/off switch provides a convenient way for users to control the robot's power supply, allowing them to turn it on or off as needed without the need for complex programming or additional hardware. This simplicity makes the robot user-friendly and accessible to a wide range of users, including children and the elderly.

4) CONCEPT DESIGN-4:



PET ROBOT

DESCRIPTION

A pet robot equipped with an ultrasonic sensor for obstacle avoidance, an external on/off switch, and a dynamic programming port combines several key features to enhance its functionality and versatility.

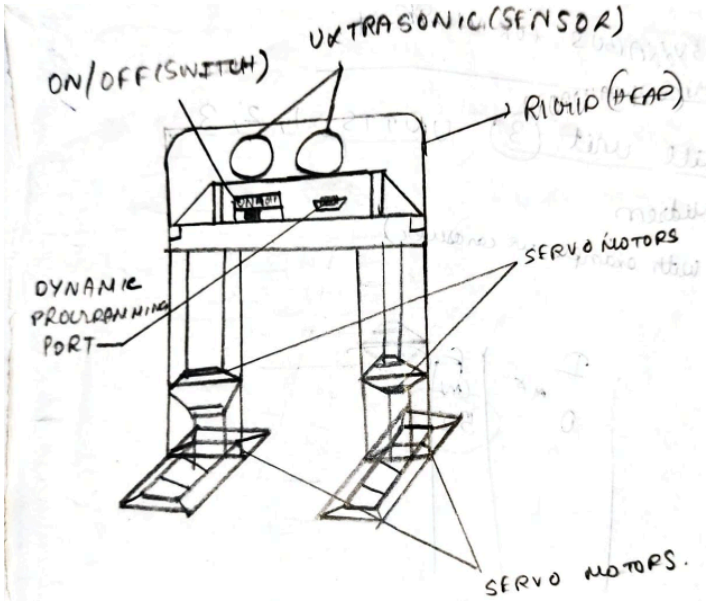
The ultrasonic sensor enables the pet robot to detect obstacles in its path and navigate around them autonomously.

The external on/off switch provides a convenient way for users to control the robot's power status externally.

The dynamic programming port adds another layer of versatility to the pet robot by allowing users to customize its behavior and functionality. By connecting external devices or programming interfaces to the port, users can modify the robot's software, add new features, or integrate it with other systems.

PET ROBOT

5) CONCEPT DESIGN-5:



DESCRIPTION

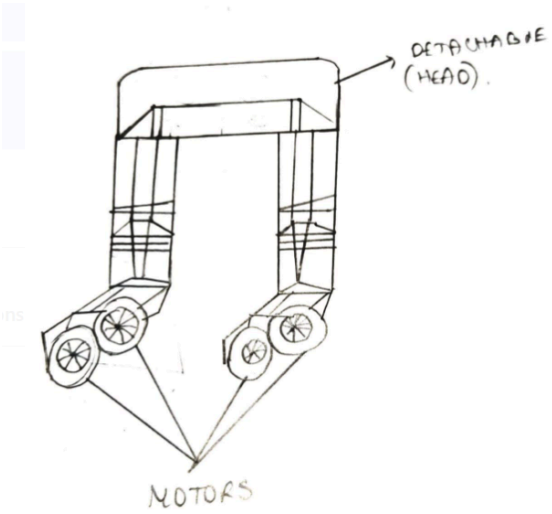
PET ROBOT

The integration of an ultrasonic sensor for obstacle avoidance, an external on/off switch, and a dynamic programming port in a pet robot enhances its functionality and versatility, allowing for autonomous navigation, user control, and customization. However, the rigid design of the head, where these components are housed, limits the modularity of the robot and reduces its ability to adapt to different needs and scenarios.

In the case of the pet robot with a rigid head, the lack of dismantlability in the head assembly hinders modularity. If a component within the head, such as the ultrasonic sensor or the on/off switch, malfunctions or needs to be upgraded, users may face difficulties accessing or replacing the component. This limitation restricts the robot's ability to adapt to changing requirements or preferences, potentially leading to increased maintenance costs and reduced user satisfaction.

6) CONCEPT DESIGN-6:

PET ROBOT



DESCRIPTION

Absence of an ultrasonic sensor for obstacle avoidance limits the robot's ability to navigate its environment autonomously. Without this sensor, the robot may struggle to detect and avoid obstacles, potentially leading to collisions or restricted movement in cluttered spaces.

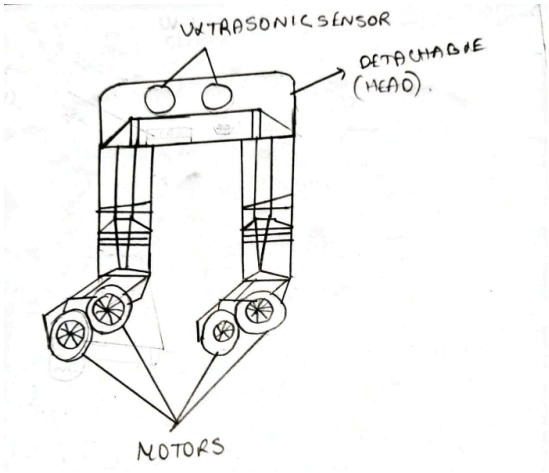
PET ROBOT

The requirement to remove the robot's head for on/off control introduces a significant inconvenience for users, detracting from the overall user experience. Having to dismantle the head each time to power the robot on or off adds unnecessary complexity and effort, reducing user satisfaction and convenience.

Furthermore, while the robot's legs contain DC motors for linear movement, the absence of features for walking, dancing, or other dynamic movements limits its ability to emulate the behavior of a pet or perform engaging interactions. This constraint may diminish the robot's appeal and entertainment value, particularly for users seeking interactive and lifelike experiences.

7) CONCEPT DESIGN-7:

PET ROBOT



DESCRIPTION

The pet robot described features several key design elements aimed at enhancing its functionality and usability. While it lacks dynamic programming capabilities, its modular head design and linear movement legs contribute to its versatility and ease of use.

The robot's head, designed to be dismantlable, increases modularity by allowing users to easily detach and replace components as needed. This modular design facilitates maintenance, repair, and

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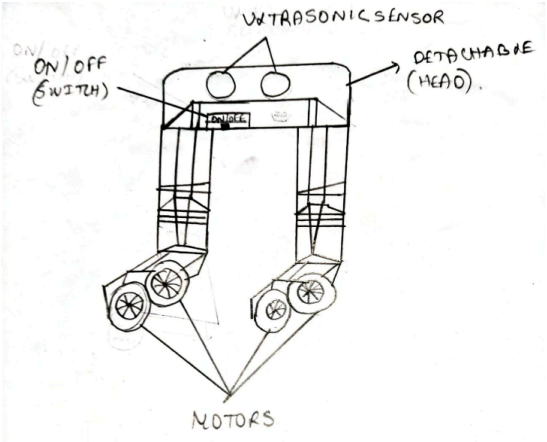
customization, enabling users to adapt the robot to different tasks or environments without requiring complex programming.

Additionally, the robot's legs incorporate DC motors for linear movement, providing basic mobility capabilities such as forward and backward motion. While these legs do not enable the robot to walk, dance, or perform complex maneuvers like a pet, they offer simple and reliable locomotion suitable for basic navigation tasks.

8) CONCEPT DESIGN-8:



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DESCRIPTION

The inclusion of an external on/off switch adds convenience for users, allowing them to control the robot's power status easily and intuitively. This simple feature enhances usability without the need for complex controls or interfaces.

While the robot does not feature dynamic programming capabilities, its head is designed to be dismantlable, increasing modularity and versatility. This means that users can easily access and modify the internal components of the robot's head, such as sensors or electronics, for customization or repair purposes. This enhances the robot's adaptability and longevity, allowing for future upgrades or modifications as needed.

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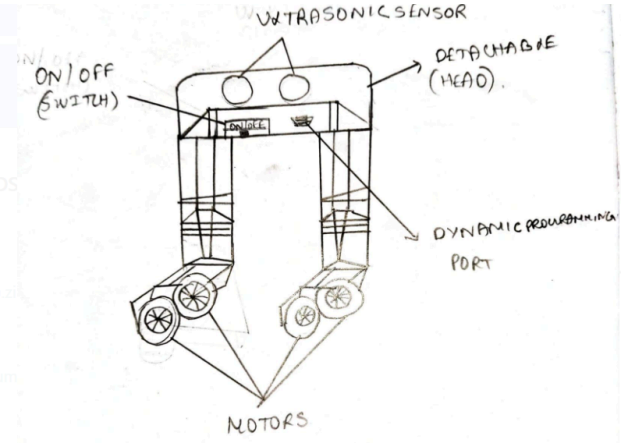
9) CONCEPT DESIGN-9:



DESCRIPTION

Adding an external on/off switch provides users with convenient control over the robot's power status, improving usability and safety by allowing for easy

activation or deactivation of the robot without accessing its internal components.

The incorporation of dynamic programming capabilities allows users to customize the robot's behavior and functionality according to their specific needs and preferences. This flexibility enhances the robot's adaptability to different tasks and environments, making it a more versatile companion.

Although the robot's legs contain DC motors for linear movement, they are not designed to mimic the walking, dancing, or other complex motions of a pet. Instead, the focus is on providing reliable and efficient locomotion for basic navigation tasks. This simpler movement mechanism reduces complexity and cost while still allowing the robot to perform essential functions such as moving from one location to another.

10) CONCEPT DESIGN-10:

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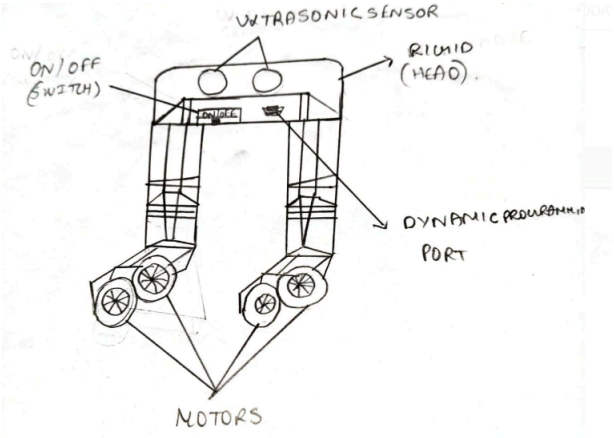

DESCRIPTION

This pet robot combines several features to enhance its functionality and versatility. Equipped with an ultrasonic sensor for obstacle avoidance and an external on/off switch, it provides convenience and safety for users. Additionally, its dynamic programming capability allows for customization and adaptability to various tasks.

However, the rigidity of the robot's head limits its modularity, as it cannot be dismantled or reconfigured easily. This constraint may hinder the robot's ability to adapt to different applications or environments.

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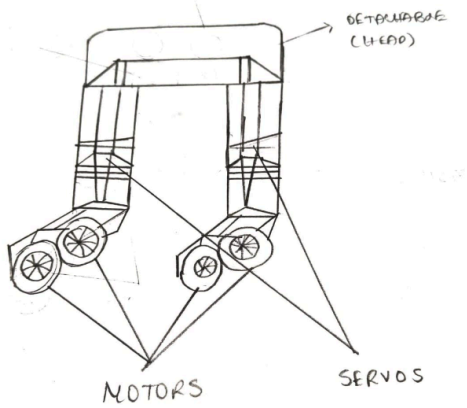
Furthermore, while the robot's legs contain DC motors for linear movement, they do not enable complex motions such as walking, dancing, or other pet-like behaviors. This limitation restricts the robot's range of capabilities and may impact its appeal as a pet companion.

11) CONCEPT DESIGN-11:



DESCRIPTION

By omitting ultrasonic sensors for obstacle avoidance and instead focusing on linear movement facilitated by DC motors in the legs, the design streamlines functionality while maintaining practicality.

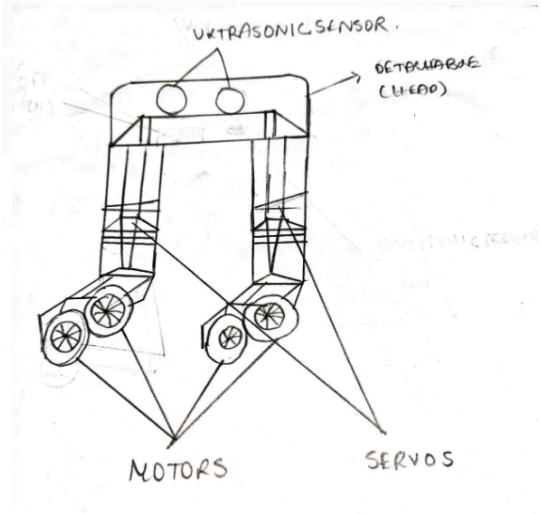
PET ROBOT

The decision to make the robot's head dismantlable enhances its modularity, allowing for easy customization or replacement of components as needed. This modular approach facilitates maintenance and upgrades, ensuring the robot remains adaptable to evolving needs and preferences.

Additionally, the inclusion of two servo motors on the leg joints below the fore limbs enables omnidirectional movement, providing versatility in navigation while still keeping the robot's locomotion relatively straightforward. However, the design intentionally limits the robot's capabilities to walking or dancing, focusing instead on basic mobility and functionality.

12) CONCEPT DESIGN-12:

PET ROBOT



DESCRIPTION

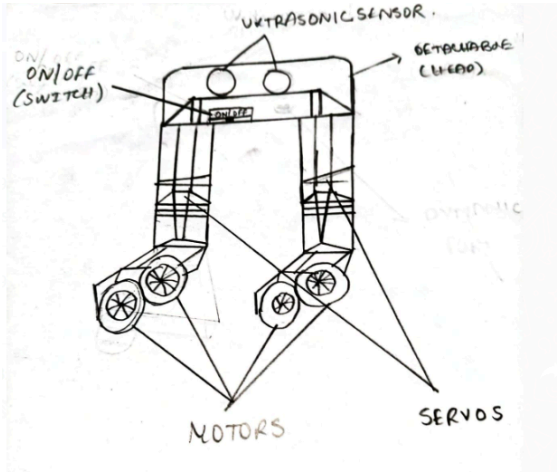
This pet robot is designed with a modular head, allowing for easy disassembly and reassembly. This modular design increases its versatility and adaptability, as users can customize or upgrade the head components as needed. The inclusion of an ultrasonic sensor in the head enables the robot to detect obstacles and navigate its environment autonomously, enhancing its functionality and safety.

The robot's legs are equipped with DC motors, providing linear movement capabilities. While these motors allow the robot to move forward, backward, and turn, they do not

PET ROBOT

enable it to walk or dance like a pet. However, the addition of two servo motors at the leg joints below the fore limbs enhances the robot's maneuverability, allowing it to move in all directions.

13) CONCEPT DESIGN-13:



DESCRIPTION

The ultrasonic sensor enables it to detect obstacles and navigate around them autonomously, ensuring safe movement in its environment.

PET ROBOT

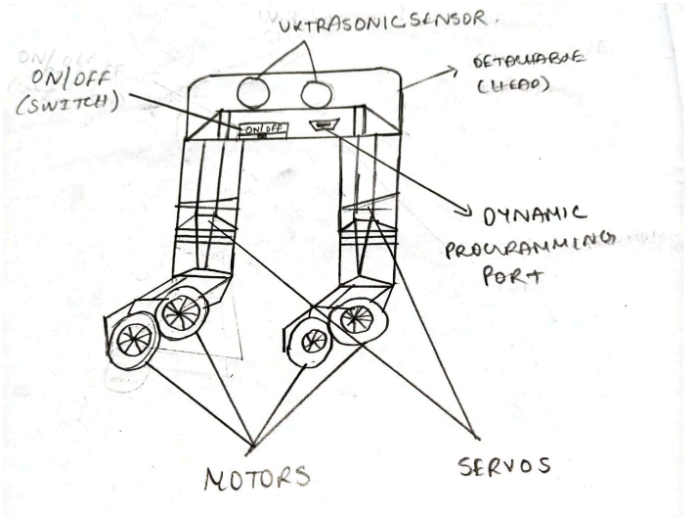
The external on/off switch provides a convenient way for users to control the robot's power status, enhancing usability and safety.

The dismantable head increases modularity, allowing for easier maintenance, repair, or customization of the robot's components. This modularity enhances versatility and adaptability to different tasks or environments.

While the robot's legs contain DC motors for linear movement, they are not designed to mimic the walking or dancing motions of a pet. Instead, the inclusion of servo motors on the leg joints below the fore limbs enables the robot to move in all directions, providing flexibility in its locomotion. However, these features do not enable the robot to perform complex behaviors like dancing or mimicking pet-like behaviors.

14) CONCEPT DESIGN-14:

PET ROBOT



DESCRIPTION

This pet robot is designed with a focus on functionality and versatility. The inclusion of an ultrasonic sensor allows it to navigate its environment safely by detecting obstacles and adjusting its path accordingly. An external on/off switch provides users with convenient control over the robot's power status.

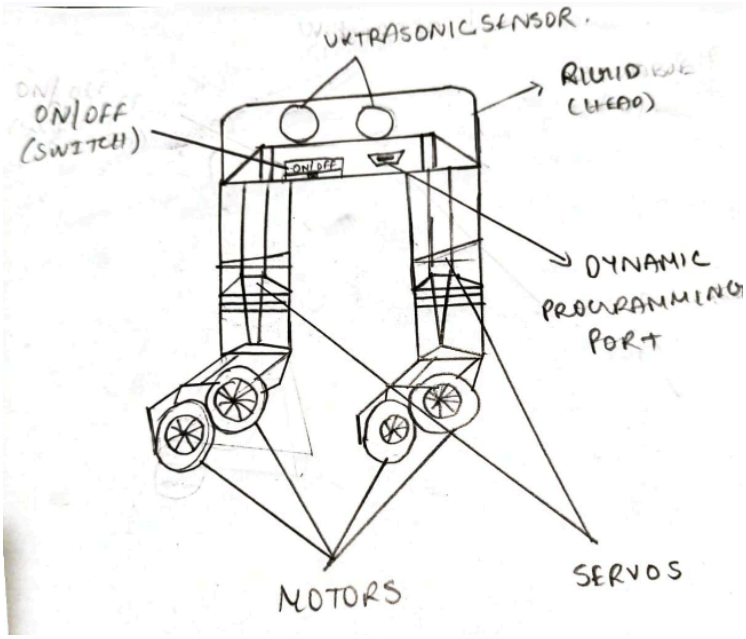
One notable feature is the modularity of the robot's head, which enhances its adaptability and ease of maintenance. By making the head dismantlable, users can easily access internal components for repairs or

upgrades, increasing the overall modularity of the robot.

Additionally, the presence of a dynamic programming port allows users to customize the robot's behavior and functionality according to their specific needs. This feature adds flexibility and expandability to the robot, enabling it to adapt to various tasks or environments.

15) CONCEPT DESIGN-15:

PET ROBOT



DESCRIPTION

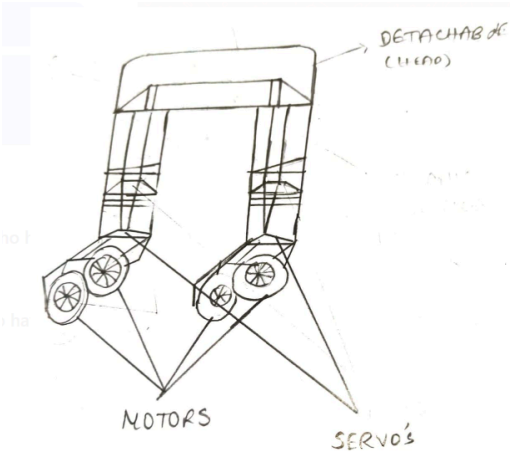
This pet robot is designed with a focus on functionality and versatility. The inclusion of an ultrasonic sensor allows it to navigate its environment safely by detecting obstacles and adjusting its path accordingly. An external on/off switch provides users with convenient control over the robot's power status.

PET ROBOT

One notable feature is the modularity of the robot's head, which enhances its adaptability and ease of maintenance. By making the head dismantlable, users can easily access internal components for repairs or upgrades, increasing the overall modularity of the robot.

Additionally, the presence of a dynamic programming port allows users to customize the robot's behavior and functionality according to their specific needs. This feature adds flexibility and expandability to the robot, enabling it to adapt to various tasks or environments.

16) CONCEPT DESIGN-16:



PET ROBOT

DESCRIPTION

Firstly, the absence of an ultrasonic sensor for obstacle avoidance suggests that the robot's navigation relies on alternative methods or is controlled manually

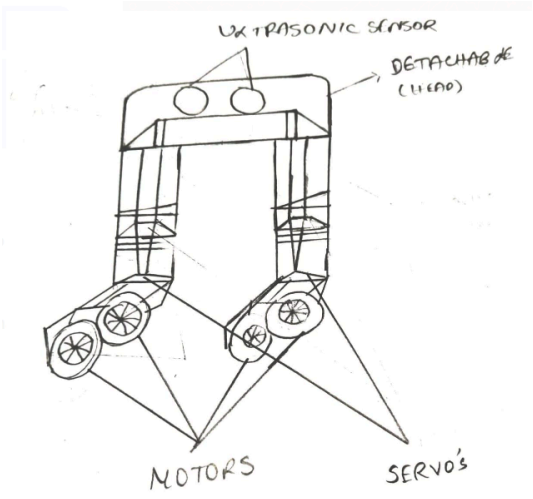
Secondly, the head of the robot is designed to be dismantled every time it needs to be turned on or off. While this approach may seem unconventional, it could simplify the power control mechanism and reduce the risk of accidental activation.

The robot's locomotion is achieved through DC motors in its legs, enabling linear movement but not the complex motions required for walking, dancing, or pet-like behaviors. However, the inclusion of two servo motors in its ankle joints allows

PET ROBOT

the robot to move in all directions and maintain stability while walking. This design compromise sacrifices some of the pet-like behaviors for simplicity and cost-effectiveness while still enabling basic locomotion and maneuverability.

17) CONCEPT DESIGN-17:



DESCRIPTION

Firstly, the inclusion of an ultrasonic sensor for obstacle avoidance enables the robot to

PET ROBOT

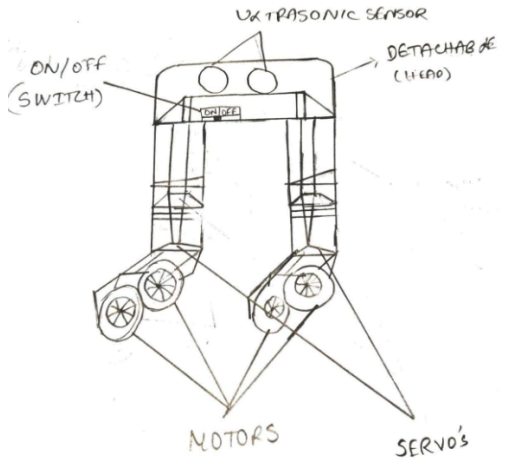
navigate its environment safely by detecting and avoiding obstacles in its path. This feature enhances the robot's autonomy and reduces the risk of collisions.

However, the design decision to make the robot's head dismantlable for power control purposes may present challenges in terms of user convenience. Having to open the robot's head every time to turn it on or off could be cumbersome and detract from the overall user experience.

Regarding locomotion, the robot's legs are equipped with DC motors, which enable linear movement but do not facilitate more complex actions such as walking or dancing. However, the addition of two servo motors at the ankle joints allows the robot to move in all directions, enhancing its maneuverability.

18) CONCEPT DESIGN-18:

PET ROBOT



DESCRIPTION

The robot's ultrasonic sensor enables it to detect obstacles and navigate around them autonomously, ensuring safe movement in its environment. Its head is designed to be dismantlable, increasing modularity and allowing for easy maintenance or customization. The external on/off switch provides a convenient way

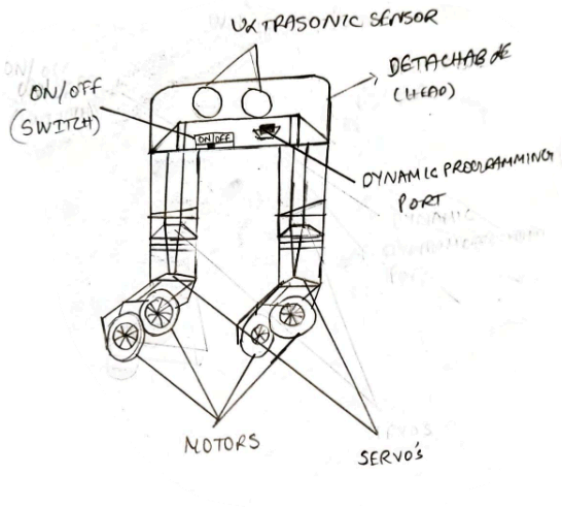
PET ROBOT

to control the robot's power status externally, enhancing user convenience and safety.

While the robot's legs contain DC motors for linear movement, they are not designed to simulate pet-like walking or dancing motions. Instead, two servo motors on its ankle joint enable it to walk in all directions, enhancing maneuverability without the complexity of pet-like behaviors. However, the robot is not capable of complex movements such as dancing or mimicking pet behaviors due to its design limitations.

19) CONCEPT DESIGN-19:

PET ROBOT



DESCRIPTION

This pet robot is designed with a focus on modularity, functionality, and ease of use. It features an ultrasonic sensor for obstacle avoidance, ensuring safe navigation in various environments. The head of the robot is designed to be easily dismantled, enhancing modularity and allowing for convenient maintenance or customization. Additionally, an external on/off switch provides simple control over the robot's power status, enhancing usability.

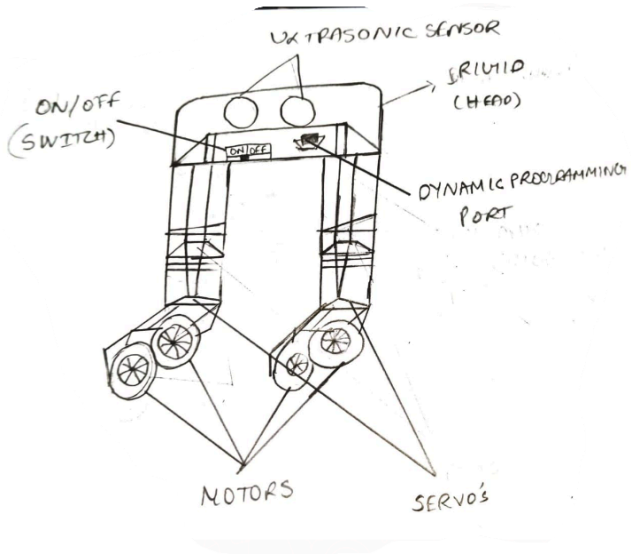
PET ROBOT

The inclusion of a dynamic programming port offers flexibility and expandability, allowing users to customize the robot's behavior or add new features as needed. The robot's legs are equipped with DC motors, enabling linear movement and basic locomotion capabilities. However, the robot is not designed to walk or dance like a traditional pet.

To provide additional mobility and versatility, the robot features two servo motors at its ankle joints. While these motors enable the robot to walk in all directions, they do not allow for complex movements such as dancing or exhibiting pet-like behaviors.

PET ROBOT

20) CONCEPT DESIGN-20:



DESCRIPTION

The ultrasonic sensor enables the robot to detect obstacles and navigate around them, promoting autonomous movement in its environment. However,

PET ROBOT

the rigid head decreases modularity, limiting the ability to customize or upgrade this component easily.

The external on/off switch provides a convenient means of controlling the robot's power status, enhancing usability and safety for users. Meanwhile, the dynamic programming port offers flexibility by allowing users to customize the robot's behavior or add new features as needed.

The robot's movement is facilitated by DC motors in its legs, allowing for linear motion but not complex maneuvers like walking or dancing. However, the inclusion of servo motors at the ankle joint enables the robot to walk in all directions, enhancing its mobility and versatility.

PET ROBOT

CONCEPT SELECTION:

1) CONCEPT SCREENING:

SELECTION CRITERIA	CONCEPTS			
	CONCEPT-1	CONCEPT-2	CONCEPT-3(REFERENCE)	CON
USER CONVENIANCE	-1	-1	0	
EASE OF HANDLING	-1	-1	0	
OBSTACLE AVOIDANCE	-1	0	0	
ON/OFF SWITCH (CONVENIANCE)	-1	-1	0	
MODULARITY	-1	-1	0	

PET ROBOT

DISMANTABILITY	0	0	0	
DYNAMIC PROGRAMMING	0	0	0	
DESIGN/ERGONOMICS	-1	0	0	
USER INTERFACE	-1	0	0	
INDUSTRIAL DESIGN	-1	0	0	
FEATURES	-1	-1	0	
PRICE	1	1	0	
TOTAL SCORE	-8	-4	0	

SELECTION CRITERIA	CONCEPTS			
	CONCEPT-5	CONCEPT-6	CONCEPT-7	CON
USER CONVENIANCE	1	-1	0	
EASE OF HANDLING	1	-1	-1	
OBSTACLE AVOIDANCE	1	-1	0	
ON/OFF SWITCH (CONVENIANCE)	1	-1	-1	
MODULARITY	-1	-1	0	
DISMANTABILITY	-1	0	0	
DYNAMIC PROGRAMMING	1	0	0	
DESIGN/ERGONOMICS	1	-1	-1	

PET ROBOT

USER INTERFACE	-1	-1	-1	
INDUSTRIAL DESIGN	1	-1	0	
FEATURES	-1	-1	-1	
PRICE	-1	1	1	
TOTAL SCORE	2	-8	-4	

SELECTION CRITERIA	CONCEPTS			
	CONCEPT-9	CONCEPT-10	CONCEPT-11	CON
USER CONVENIANCE	1	1	-1	
EASE OF HANDLING	1	1	-1	
OBSTACLE AVOIDANCE	1	1	0	
ON/OFF SWITCH (CONVENIANCE)	1	1	-1	
MODULARITY	1	-1	-1	
DISMANTABILITY	0	-1	0	
DYNAMIC PROGRAMMING	1	1	0	
DESIGN/ERGONOMICS	1	1	-1	
USER INTERFACE	1	1	-1	
INDUSTRIAL DESIGN	1	1	-1	
FEATURES	-1	-1	-1	
PRICE	-1	-1	1	

PET ROBOT

TOTAL SCORE	7	3	-7	

SELECTION CRITERIA	CONCEPTS			
	CONCEPT-13	CONCEPT-14	CONCEPT-15	CON
USER CONVENIANCE	1	1	1	
EASE OF HANDLING	1	1	1	
OBSTACLE AVOIDANCE	1	1	1	
ON/OFF SWITCH (CONVENIANCE)	1	1	1	
MODULARITY	0	1	-1	
DISMANTABILITY	0	0	-1	
DYNAMIC PROGRAMMING	0	1	1	
DESIGN/ERGONOMICS	0	1	0	
USER INTERFACE	0	1	1	
INDUSTRIAL DESIGN	0	1	1	
FEATURES	-1	-1	-1	
PRICE	0	-1	1	
TOTAL SCORE	3	7	2	

PET ROBOT

SELECTION CRITERIA	CONCEPTS			
	CONCEPT-17	CONCEPT-18	CONCEPT-19	CON
USER CONVENIANCE	0	1	1	
EASE OF HANDLING	-1	1	1	
OBSTACLE AVOIDANCE	1	1	1	
ON/OFF SWITCH (CONVENIANCE)	-1	1	1	
MODULARITY	-1	1	1	
DISMANTABILITY	0	0	0	
DYNAMIC PROGRAMMING	0	0	1	
DESIGN/ERGONOMICS	-1	0	0	
USER INTERFACE	0	1	1	
INDUSTRIAL DESIGN	-1	0	1	
FEATURES	-1	-1	-1	
PRICE	1	0	-1	
TOTAL SCORE	-4	5	6	

PET ROBOT

CONVENTIONS:

1. W.S: WEIGHTED SCORE.
2. R: RATING.

SELECTION CRITERIA	WEIGHT (%)	CONCEPT		CONCEPT		CONCEPT		CONCEPT	
	(100%)	R	W. S	R	W. S	R	W. S	R	W. S
USER CONVENIANCE	5%	4	0.2	1	0.05	3	0.15	3	0.15
EASE OF HANDLING	10%	4	0.4	1	0.1	3	0.3	3	0.3
OBSTACLE AVOIDANCE	10%	4	0.4	0	0	3	0.3	3	0.3
ON/OFF SWITCH	5%	4	0.2	0	0	0	0	3	0.15
(CONVENIANCE)	(100%)	R	W. S	R	W. S	R	W. S	R	W. S
MODULARITY	12%	3	0.36	1	0.12	3	0.36	3	0.36
USER CONVENIANCE	5%	2	0.1	3	0.15	4	0.2	3	0.15
EASE OF HANDLING	10%	5	0.5	2	0.2	4	0.4	5	0.5
PROGRAMMING OBSTACLE	10%	0	0	4	0.4	4	0.4	4	0.4
DESIGN/ERGONOMICS	5%	4	0.2	2	0.1	2	0.1	3	0.1
USER INTERFACE ON/OFF SWITCH	5%	0	0.15	2	0.1	2	0.1	2	0.1
INDUSTRIAL DESIGN	5%	3	0.15	2	0.1	2	0.1	2	0.1
MODULARITY FEATURES	12%	3	0.45	2	0.24	3	0.36	4	0.48
DISMANTABILITY	3%	2	0.06	3	0.09	3	0.09	2	0.06
TOTAL SCORE PROGRAMMING	15%	0	3.58	0	2.22	0	3.25	5	4.52
RANK			3		14		6		12
DESIGN/ERGONOMICS	5%	2	0.1	3	0.15	4	0.2	4	0.2
USER INTERFACE	5%	2	0.1	3	0.15	4	0.2	4	0.2
INDUSTRIAL DESIGN	5%	1	0.05	2	0.1	3	0.15	4	0.2
FEATURES	15%	1	0.15	2	0.3	3	0.45	5	0.75
PRICE	3%	4	0.12	3	0.09	2	0.6	2	0.06
TOTAL SCORE			1.06		1.98		3.46		4.34
RANK			19		15		5		1

PET ROBOT

	(100%)	R	W. S	R	W. S	R	W. S	R	W. S
USER CONVENIANCE	5%	3	0.15	3	0.15	3	0.15	2	0.1
EASE OF HANDLING	10%	3	0.3	3	0.3	3	0.3	2	0.2
OBSTACLE AVOIDANCE	10%	3	0.3	3	0.3	3	0.3	3	0.3
ON/OFF SWITCH (CONVENIANCE)	5%	3	0.15	3	0.15	3	0.15	3	0.15
MODULARITY	12%	3	0.36	3	0.36	2	0.24	2	0.24
DISMANTABILITY	10%	3	0.3	2	0.2	2	0.2	2	0.2
DYNAMIC PROGRAMMING	15%	3	0.45	3	0.45	3	0.45	3	0.45
DESIGN/ERGONOMICS	5%	3	0.15	3	0.15	3	0.15	2	0.1
USER INTERFACE	5%	3	0.15	3	0.15	2	0.1	2	0.1
INDUSTRIAL DESIGN	5%	3	0.15	3	0.15	3	0.15	3	0.15
FEATURES	15%	3	0.45	4	0.6	4	0.6	2	0.3
PRICE	3%	3	0.09	2	0.06	3	0.09	4	0.12
TOTAL SCORE			3.69		3.87		3.69		2.87
RANK			12		8		12		18

	(100%)	PET ROBOT							
		R	W. S	R	W. S	R	W. S	R	W. S
USER CONVENIANCE	5%	2	0.1	3	0.15	4	0.2	3	0.15
EASE OF HANDLING	10%	2	0.2	3	0.3	3	0.3	3	0.3
OBSTACLE AVOIDANCE	10%	3	0.3	3	0.3	3	0.3	3	0.3
ON/OFF SWITCH (CONVENIANCE)	5%	0	0	2	0.1	2	0.1	2	0.1
MODULARITY	12%	2	0.24	3	0.36	4	0.48	3	0.36
DISMANTABILITY	10%	2	0.2	3	0.3	4	0.4	3	0.3
DYNAMIC PROGRAMMING	15%	0	0	0	0	4	0.6	4	0.6
DESIGN/ERGONOMICS	5%	3	0.15	3	0.15	4	0.2	4	0.2
USER INTERFACE	5%	3	0.15	3	0.15	3	0.15	3	0.15
INDUSTRIAL DESIGN	5%	2	0.1	2	0.1	3	0.15	3	0.15
FEATURES	15%	2	0.3	3	0.45	4	0.6	3	0.45
PRICE	3%	4	0.12	3	0.09	2	0.06	2	0.06
TOTAL SCORE			1.86		2.42		3.54		3.12
RANK			16		13		4		7

FUNCTIONAL DECOMPOSITION

FUNCTION	DECOMPOSITION

PET ROBOT

Obstacle Avoidance	• **Sensor Module**: Includes the ultrasonic sensor for detecting obstacles. • **Navigation Control**: Processes sensor data and adjusts robot's movement to avoid obstacles.
Modularity	• **Structural Design**: Incorporates modular components that can be easily assembled or disassembled. • **Interchangeable Parts**: Allows for swapping out or upgrading individual modules without affecting the overall functionality.

PET ROBOT

Dismantlability	• **Fastening Mechanisms:** Utilizes easily removable fasteners or connectors for disassembly (SCREWS,BOLTS). • **Component Accessibility:** Ensures internal components are accessible for maintenance or repair.
Dynamic Programming Port	• **Interface Module:** Provides a port or interface for connecting external devices for programming or customization. • **Communication Protocol:** Facilitates data transfer between

PET ROBOT

	the robot and external programming devices (USB/UART).
Walking	• **Leg Movement Control**: Coordinates the movement of servo motors to enable walking motion. • **Gait Control:** Defines the pattern and rhythm of leg movement for stable and efficient walking.
Dancing	• **Choreography Module**: Programs predefined dance routines or sequences. • **Motion Coordination:** Synchronizes movements of various actuators (e.g., servos)

PET ROBOT

	to perform dance steps.
Sound Effects	• **Audio Module:** Includes speakers or sound-generating devices for producing sounds. • **Sound Control:** Coordinates the playback of pre-recorded sounds or generates sound effects in response to specific events or commands.
External On/Off Switch	• **Power Management:** Controls the robot's power supply and

PET ROBOT

	enables users to turn the robot on or off externally. • **Safety Interlock:** Ensures the robot can only be powered on or off, when necessary, safety conditions are met.

GANTT CHART (PROJECT SHEDULE)

PRODUCT	APRIL	MAY
Sales		

PET ROBOT

Product Development		
Equipment and Tooling		
Production Ramp Up		
Marketing and Support		
Production		

USER INTERFACE (PET ROBOT)

INTERFACE	CONCEPTS
Main Control Panel	• Central display screen showing the robot's status, mode, and available options. • Navigation buttons or touch screen for menu selection and navigation.

PET ROBOT

Obstacle Avoidance	• Toggle switch or button to enable/disable obstacle avoidance mode. • Option to choose between different obstacle detection sensors (e.g., IR, ultrasonic).
Modularity and Dismantlability	• Interactive guide or tutorial on how to assemble, disassemble, and customize the robot. • Menu option to access modular components for replacement or modification.
Dynamic Programming Port	• USB port or programming interface

PET ROBOT

	for connecting external programming devices. ● On-screen instructions for uploading new programs or modifying robot behavior.
Walking and Dancing	● Control buttons or sliders for initiating walking and dancing modes. ● Adjustable parameters for walking speed, step size, and dance routines.
Sound Effects	● Volume control slider for adjusting sound effects and music playback. ● Selection of pre-loaded sound effects or music

PET ROBOT

	tracks for different robot actions.
External On/Off Switch	• Physical switch or button to power the robot on or off externally. • Confirmation prompts to prevent accidental power toggling.
Sensor Calibration	• Menu option for calibrating obstacle detection sensors and adjusting sensitivity. • Visual feedback (e.g., LED indicators) to show sensor status and calibration results.

PET ROBOT

PROBLEM DECOMPOSITION BY SEQUENCE OF USER ACTIONS

PET ROBOT

SUBPROBLEMS	CONCEPT-1	CONCEPT-2
OBSTACLE AVOIDANCE	ULTRASONIC SENSOR	INFRARED (IR) SENSORS
ON/OFF SWITCH	EXTERNAL	INTERNAL
DYNAMIC PROGRAMMING	USB PORT	ETHERNET PORT
ERGONOMICS	SOFT EDGES	SMOOTH SURFACE
MODULARITY	DISMANTABILITY	SERVICEABILITY
USER INTERFACE	ON/OFF SWITCH	RECHARGABLE
WALKING, DANCING	SERVO MOTORS	GEAR MOTORS
SOUND EFFECTS	BUZZER	SPEAKERS

PET ROBOT

PRICE	LOW DENSITY MATERIALS	MODERATE DENSITY MATERIALS

PET ROBOT

SETTING FINAL SPECIFICATIONS

S No.	FEATURES	UNITS	VA

PET ROBOT

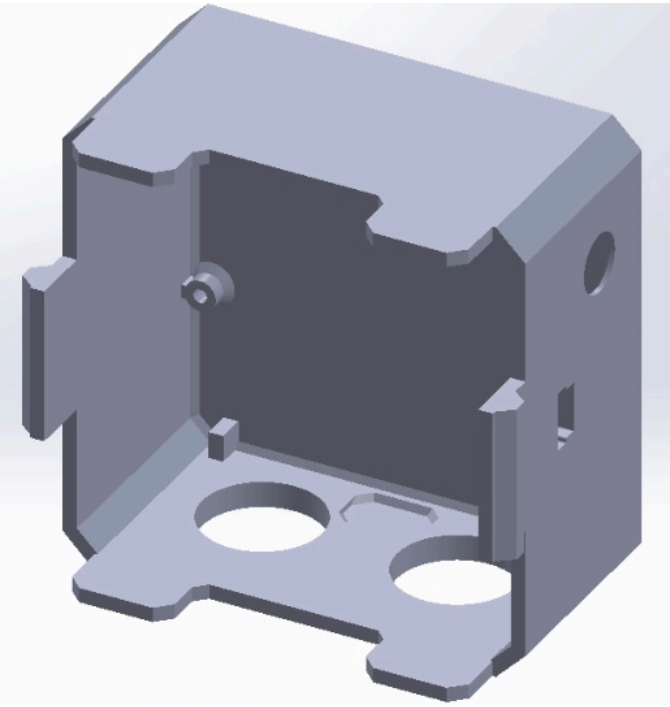
PET ROBOT

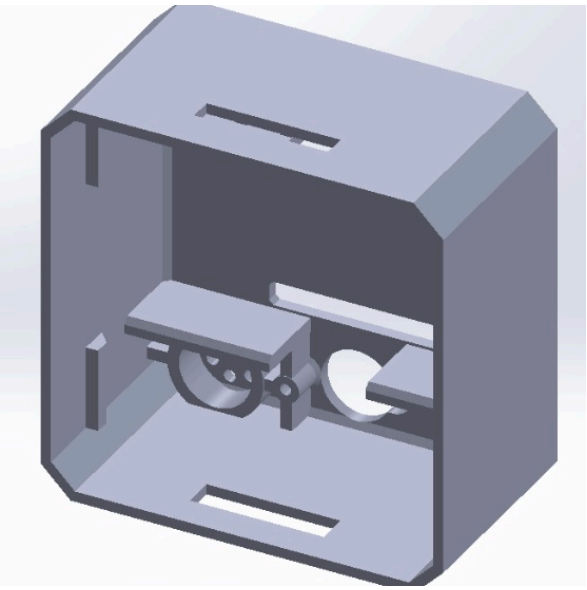
MODELLING AND PROTOTYPING

PRODUCT: PET ROBOT.

1) PERCEPTION UNIT:

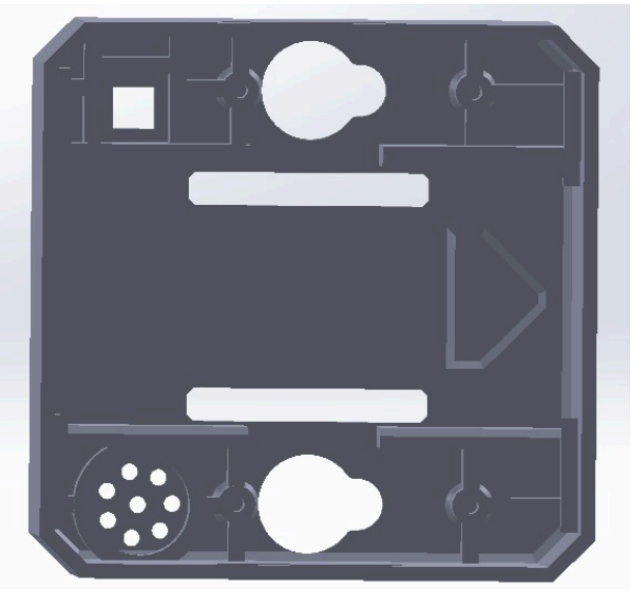
PET ROBOT





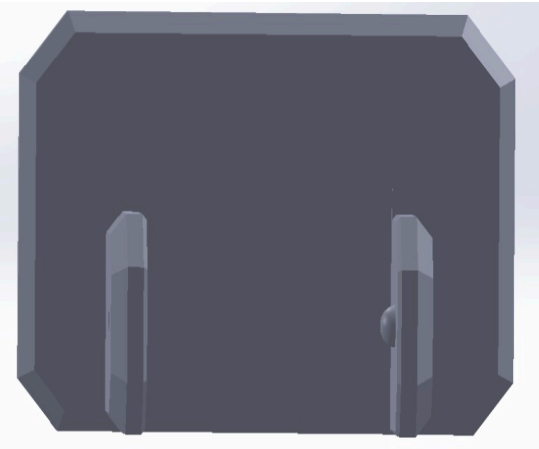
PET ROBOT

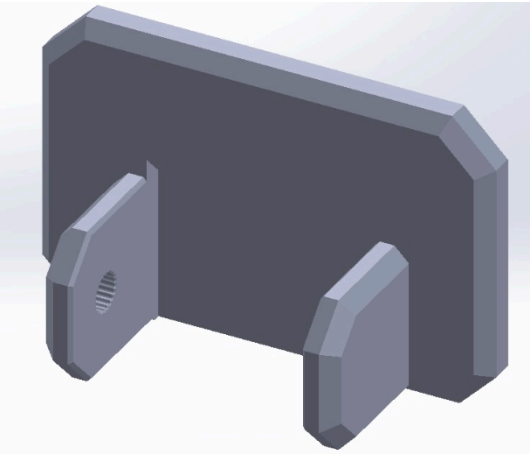
2) PERCEPTION UNIT (BASE):



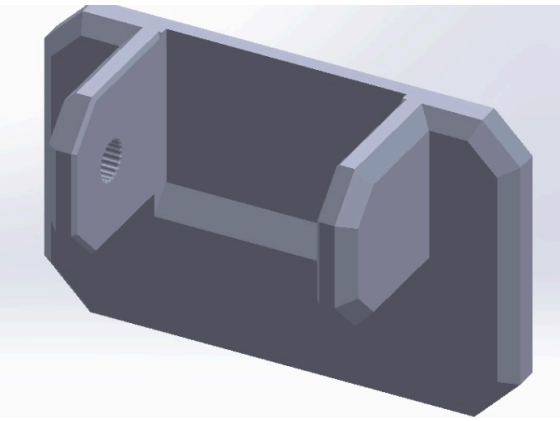
PET ROBOT

3) LEFT FOOT:



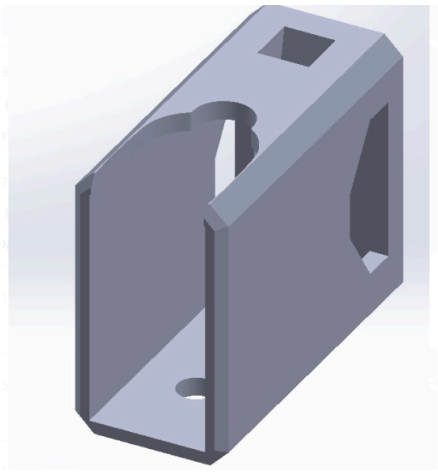


4) RIGHT FOOT:



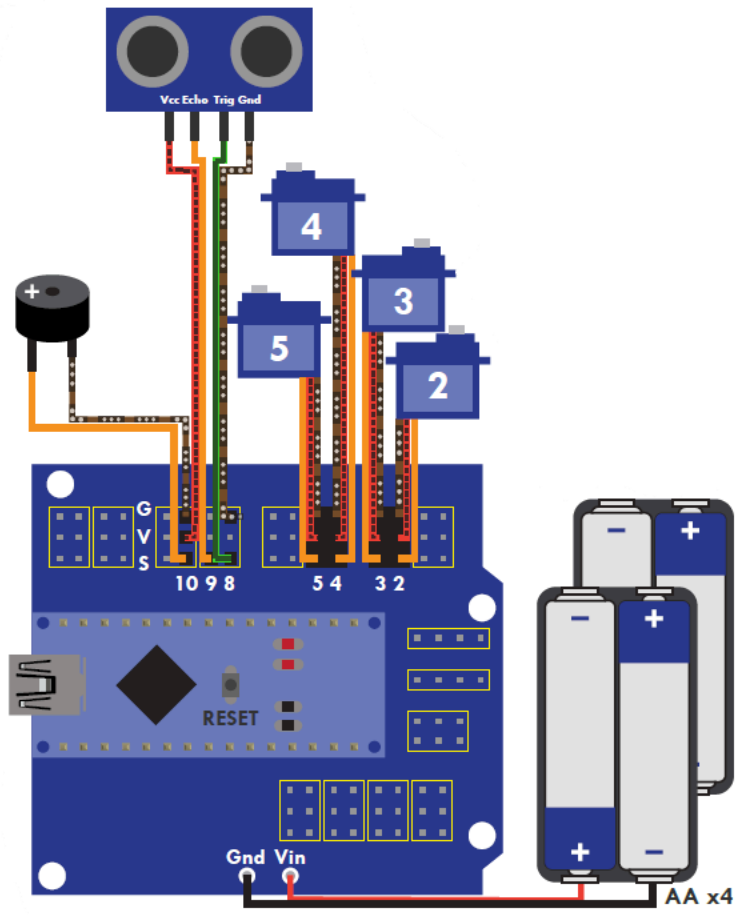
PET ROBOT

5) LEG (RIGHT, LEFT):



CIRCUIT DIAGRAM

PET ROBOT



THANK YOU