UNIVERSE ARTIFICIAL PETS

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Abstract— Humans are social creatures. Unfriendly, isolated, and harsh space conditions will affect an astronaut's psychological state and could cause stress or depression to the astronaut due to a lack of social interactions. Cat is one of the most popular pets in the world. Cat is said to have positive effects on humans, such as reducing stress, lowering blood pressure, and reducing the risk of heart attacks. The idea in this study was to design a realistic cat-shaped robot that could accompany and interact with astronauts as they explore space. This robot can be equipped with functions to detect the astronaut's mood using an infrared sensor, a smart communication bracelet for two-way communications with the astronauts, a graceful hind and strong muscles to offer high flexibility in movement, and a warm, soft, and fluffy fabric that mimics cat fur. This robot is tasked with accompanying its astronaut owner on missions in space. The materials that will be used are reinforced carbon/carbon composite, steel, and titanium on the inside of the robot, and Kevlar, nylon, and faux fur on the outside of the robot.

Keywords— Astronauts, Cat, Robot, Stress

INTRODUCTION

During space exploration, astronauts tend to experience stress and depression that could be caused by several factors such as loneliness and anxiety. Humans are known to be social creatures, and the isolated condition of space exploration can limit astronauts' communications with their peers, increasing their anxiety due to loneliness (Tafforin et al., 2015). Chronic stress due to the feeling of loneliness could cause depression and social phobia, and even lead to a tendency to commit suicide. In addition, the extreme conditions in space with limited food sources and the risk of death could also increase their anxiety (Cahya, 2019).

Unfriendly, isolated, and extreme space conditions will affect the psychological condition of an astronaut. Antarctica could be one of the places that can be used to test human psychological function in space because it has an extreme environment like space (Dockrill, 2022). Research data shows that negative emotions from participants tend to increase during the test. This was caused by interactions between individuals in the research center and situational factors that occurred. The data also showed that the positive emotions of most participants were decreasing (Alfano, 2021).

The survey conducted by Forbes Advisor showed that cats are the second most popular pet in the world (Tilford, 2022). This is influenced by several factors such as their cute and adorable behavior which can also reduce feelings of loneliness at home, proven to relieve stress such as reducing hypertension and reducing the risk of heart attacks (Allen, 2003), and lastly, they are not difficult to care for as long as there is food and drink for the cat.

In this study, the design concept of a pet robot named Universe Artificial Pets which resembles a cat is explored. In this concept, the pet robot is designed to accompany and interact with the astronauts during their time exploring space.

DISCUSSION

A. Concept

This robot will be equipped with features that allow companionship, monitoring, and detection of the astronaut's mood by infrared sensor. It will also be equipped to conduct two-way communications between the robot and the astronaut to relieve the stress and pressure that build up during missions.

This work is inspired by NASA's robot dog (Nebula-Spot), a rover, the structure of a cat's hind, Siri, and the Apple watch as shown in the mood board (Fig.1).

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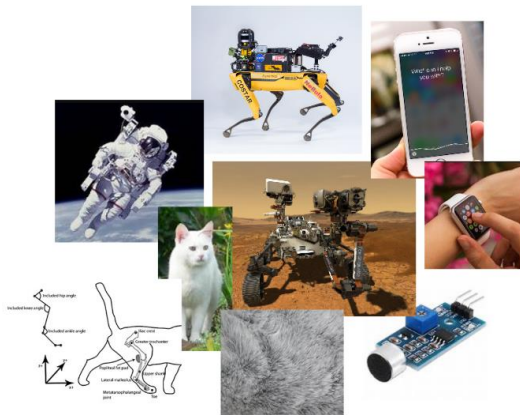*Christian Therry, Jeremiah Adrian, Vincentius Marson*

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Fig. 1. Moodboard

B. Features & Functions

This robot will have built-in infrared sensors that are connected to a smart communication bracelet that comes along with the robot cat. This smart communication bracelet allows the robot cat to communicate with the astronauts and detect their mood changes through changes in skin temperature (Dzedzickis et al., 2020). The pet cat will adjust their actions, expressions, and features based on the user's moods.

This bracelet works just like how Siri detects a human's voice in the form of sound waves and frequencies and converts the voice into codes understandable by machine (Siri Team, 2017). The codes are then analyzed through an acoustic model to identify the patterns and the keywords. The recognized voices will then trigger different algorithms with different interactive outputs from the pet cat. This feature also allows two-way communications between the robot and the astronaut which could relieve and minimize the stress and pressure building up during missions.

The robot's legs are designed with graceful hinds and strong muscles (Pratiwi & Setiawan, 2022). This feature allows the robot to jump and land efficiently. It is inspired by the structure of a cat's limbs. Cats have strong legs and back muscles. This allows them to jump several times higher than their own length, both horizontally and vertically.

Additionally, this robot is also covered with warm, soft, and fluffy fabric that imitates the cat's fur. This feature is expected to reduce the stress experienced by astronauts. It can also mimic a cat's behavior, such as purring, meowing, scratching, and grooming. Moreover, it can also be equipped with music features.

Overall, this robot pet cat is assigned to accompany their astronaut owner while they are on duty out there in space, becoming a companion to reduce boredom and avoid stress build-up due to loneliness and emptiness. It will also help the astronauts to be aware of their own mood state.

C. Prototyping

The first prototype of Universal Artificial Pets was built using paper and fur cloth. The components of the prototype were attached using adhesive tapes and hot glue,

and some parts were sewn together using needle and thread as shown in Fig.2.

Fig. 2. Initial prototype

The second prototype was improved with rasfur cloth, synthetic fur, to cover the outer parts of the body, and robotic components from the kid's toy to make it more interactive as shown in Fig.3.

Fig. 3. Final prototype

MATERIAL SELECTION

Among the various materials available nowadays, there are certain restrictions in the selection of suitable materials for the Universe Artificial Pets. Considering the features and functions, it must be light, durable, flexible, and comfortable for its purposes.

D. Inner part of the robot

Aluminum is a lightweight metal with a density around one-third of steel. To increase its strength, aluminum has been combined with other elements creating aluminum alloys with many excellent characteristics that are already used in many fields of applications (Davis, 2001). Robots constructed with aluminum will have high durability while maintaining low weight, thus improving their flexibility and movement speed without compromising the structural integrity. The high corrosion resistance and high-temperature tolerance also make aluminum alloys the suitable choice to protect delicate parts of the robot.

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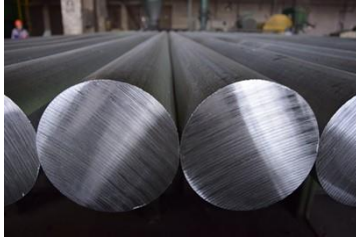
Fig. 4. Aluminum

Steel is one of the hardest and most durable materials that can be considered to make the skeleton structure of the robot (Matthews, 2019). It is a very sturdy metal that is widely available and easy to forge into any shape one may want. The high-temperature resistance will also give the robot the ability to survive in many harsh conditions that otherwise could damage other less durable materials.

Steel comes in four main types that are different in properties and purposes, namely carbon steel, alloy steel, tool steel, and stainless steel as shown in Fig.5 (Weerg, 2021). Each of these types also has many kinds of variations with specific uses. For the purpose of constructing the robot cat, combinations of these materials such as the use of carbon or alloy steel for the skeleton and stainless steel for the outer shell will allow the building of a strong and durable robot with high resistance to harsh environments.

Fig. 5. Carbon steel, alloy steel, stainless steel

E. Outer part of the robot

Kevlar is also considered one of the best materials for building a robot (Matthews, 2019). The high tolerance to hot and cold environments enables this polymer to be used as a protective layer for the robot. This material is also commonly used as a bulletproof layer in vests proving its durability against impact and pressure. Kevlar as a flexible sheet can be designed to cover the robot thoroughly to protect it in many harsh conditions and activities without hindering its movement significantly. Kevlar can also be designed in different textures, patterns, and colors, and even engraved with logos or emblems to improve the visual appearance of the robot aesthetically [14].
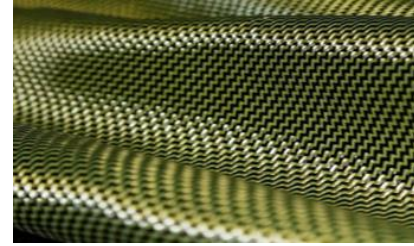

Fig. 6. Kevlar (Source: Pinterest)

Another polymer that can also be used in robotic components is nylon, a synthetic polyamide, that can be manufactured into a material with tensile strength as high as 12,000 psi, higher than most polymers currently available. It can withstand significant plastic deformation before breaking and exhibit a low coefficient of friction. This material can be used in the form of sheets or molded into various forms with high accuracy, making it the perfect material for plastic gears or other moving parts [15].

Fig. 7. Nylon

Faux fur, a type of synthetic fur made from blending acrylic and polyester fibers (Shannon Fabrics, 2019), can be used to cover the body of the cat robot to simulate real animal fur. With the springy and lightweight characteristics of the fabric, it will provide a fluffy look and feel to the robot. It can also be made in any color and texture range making it a suitable material to provide customization to the visual appearance of the cat robot. This kind of synthetic material is also resistant to heat and attack from insects providing an easy maintenance of quality.
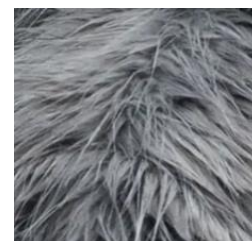

Fig. 8. Faux fur

CONCLUSION

The Universe Artificial Pets developed in this study can be a solution to reduce and minimize the stress and pressure experienced by astronauts during space explorations and missions into harsh environments. The comfort and entertainment that can be provided by this pet

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cat robot will certainly alleviate the mood of cat lovers and space travelers.

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