BioZone System Aerospace Version

In Advanced Cardiac Life Support training we are taught the A,B,Cs of Critical Care approach with ‘A’ representing the Airway and ‘B’ representing Breathing. Without ensuring a patent airway with adequate respiration and oxygen delivery to the human body death with rapidly ensue. In the document titled BioZone Priorities we investigated the pathophysiology of Radiation Induced Lung Injuries and identified specific cascading pathways of immune responses to inflammation and potentially irreversible damage to pulmonary parenchyma. It is the intention of Vertu Medical Technologies to develop the BioZone’s Bio-Atmosphere to mitigate the described harmful effects of radiation in space travel to the pulmonary tissue by interrupting this detailed detrimental sequence of events.

The Bio-Atmosphere aims to accomplish this goal by providing the novel means and methodology to strengthen the pulmonary cell’s resistance to inflammation and mitigate DNA damage through novel atomized agents diffused into the Bio-Atmosphere and thereby inhaled by the occupant for predetermined sessions. Proprietary adjuvant modalities provided by the BioZone System include an

interplay of an excimer lamp delivering far left UV light then cycled and pulsed creating a harmonic resonance effect, cycled positive and negative pressure gradients, magnetic and electromagnetic therapeutics, dithermal modulation therapy, and negative ion integration. This report will further explore the adjuvant modalities of the BioZone Project in facilitating prolonged space travel.

The ‘C’ in Advanced Cardiac Life Support represents Circulation of which space travel with zero gravity creates additional physiological challenges. Pulmonary Edema, increased Cerebrospinal Fluid in the cranial vault, flattening of the posterior eye wall, enlargement of the Pituitary Gland, swelling of the outer layer of the Optic Nerve, enlargement of the ventricles of the brain, to name a few examples, present continued unmitigated challenges for astronaut health and well being during prolonged space travel. The BioZone System introduces novel countermeasure mitigants to the consequences by means of the proprietary specialized enclosure cabinet providing cycling positive pressure to the head and torso of the chamber occupant while at the same time providing negative pressure to the lower portion of the body. With predetermined cyclical intervals, the circulatory status of the astronaut is preferably manipulated and normalized wherein reduction of facial edema, distortion of the eye and Pituitary Gland, and reduction of the CSF around the Optic Nerve and ventricles of the brain in mitigated. Vertu Medical Technologies (VMT) believes the cycled pressure gradient effect on the astronaut in zero gravity warrants further investigation.

The next letter in the Critical Care acronym is ‘D’ for Disability. This category can be applicable to a broad range of disorders all contributing to the disability of the astronaut to perform in cohesion with the team model and approach. The mental health of the team members is stated to be as important or possibly more important than the physical well being and is crucial to the success of the mission as well as to the survival of the crew. Isolation, confinement, monotony, lack of gravity and spatial orientation, anxiety and constant fear of a sudden death event, separation from family and friends, loss of strength and muscle mass, disruption of circadian rhythms, deprivation of sensory stimulations, hedonic suppression, sleep disturbance due to prolonged LED light exposure, absence of healthy sun exposure, all exemplify mandate topics that must be addressed. After all, humans are highly specialized to exist on Earth and space travel is anything but the norm.

The BioZone Project recognizes each of the debilitants mentioned and offers NASA solutions for remediation and mitigation of the problems. An initial potential debilitant yet attended, as evidenced in space station pictures of the cabin crew quarters, is ‘Clutter’ (see Fig.1 Cabin Clutter). This phenomenon initially seems simple but over prolonged space travel may lead to significant mental instability. An important factor in this discussion is to recognize that astronauts are

overachievers who undoubtedly earned their place onboard a space mission through due diligence, perseverance, determination, hard work and performance. Individual such as so described are rarely disorganized, unprepared, or unaware of their surroundings. One could even speculate a certain degree of obsession and compulsivity correlates with the superior drive and objectivity characteristic of astronauts yet the pictures of the inside of the space station is one of a clutter field that inevitably overtly or subconsciously must lead to a certain degree of angst and ‘dys-ease’ which is the precursor to the derivative ‘disease’. As a mitigant to the clutter debilitant, the BioZone Unit designs are sleek configurations with thoroughly planned organizational integration of a multitude of cooperative devices serving functional interoperability. We believe conventional bulky equipment can be replaced with space saving superior technologies such as with the BioZone Units.

Fig. (1) Cabin Clutter

The BioZone Units are designed to display in a serial array of units, each with their own applications yet communicating and interacting with collective learned input and output, each serving the benefit of the other. The core CPU logic flow controls each BioZone Unit functionality and are interfaced with AI designed to learn and

innovate, improvise and individualize, adapt and strategize in order to engage and successfully navigate the unknowns inevitable to the perils of prolonged space travel. Each BioZone Unit is capable of providing plant growth or delivering a microbiome source necessary for repletion in a confined microenvironment, providing a comprehensive and complete medical and surgical intensive care station, and providing the sanctitude or sanctorum necessary for mental, spiritual, and emotional wellbeing of the astronauts. Every BioZone unit provides an enhanced sleep chamber enriched with beneficial negative ions derived from the plant and microbe units. A symbiotic display of futuristic wall units are designed to unfold and extend into the functional apparatus intended. The BioZone Array needs to be investigated as to the ability to mitigate numerous conventional cluttered devices, wires and instruments by alternatively providing a neat and organized system prompting 'ease' instead of 'dys-ease'.

The space version **BioZone Intensive Care Unit** (**BICU**) has been designed to mitigate the medical autonomy that will exist in space wherein data transmission during a Mars mission may take up to 40 minutes to be responded to. In medicine we refer to the Golden Hour which is more appropriately a metaphorical analogy of time until appropriate intervention correlating to patient outcomes. In a Mars mission, for example, it is imperative that the craft is outfitted with a '**self-sufficient medical facility**' capable of delivering infallible healthcare to the astronauts on demand and in real time.

The spacecraft BICU comprises a comprehensive space saving all-in-one ER-ICU station with rapid convertibility into a surgical operating station with complete anesthesia capability. Unexpected life-threatening presentations such as traumatic or spontaneous pneumothorax, appendicitis, cholecystitis, compartment syndrome, perforated viscous, and even cardiac vessel occlusion may be adequately attended. The entire spectrum of disease management is within the capability of the BICU's data gathering, interpretive, diagnostic and interventional medical devices integration. Extensive medical libraries are interfaced with Artificial Intelligence that stands ready to take command in the case of a debilitated flight surgeon.

The BICU space version is designed wherein an array of monitors and medical devices fold out of travel mode once the upper section of the device is deployed. An advanced technological **BioZone Summation EKG (BEKG)** has been innovated to provide vastly superior cardiac information than conventional EKGs. AI assistance guides analysis and interpretation of the physiological status of the astronaut's cardiac status as well as providing a **novel means of cardiac biomass assessment and cardiac index parameters**. A proprietary modification of an ultrasound on a chip technology, the **Bio-Sound** provides a novel means for ultrasound enhanced **muscle mass determinations** as well as performance

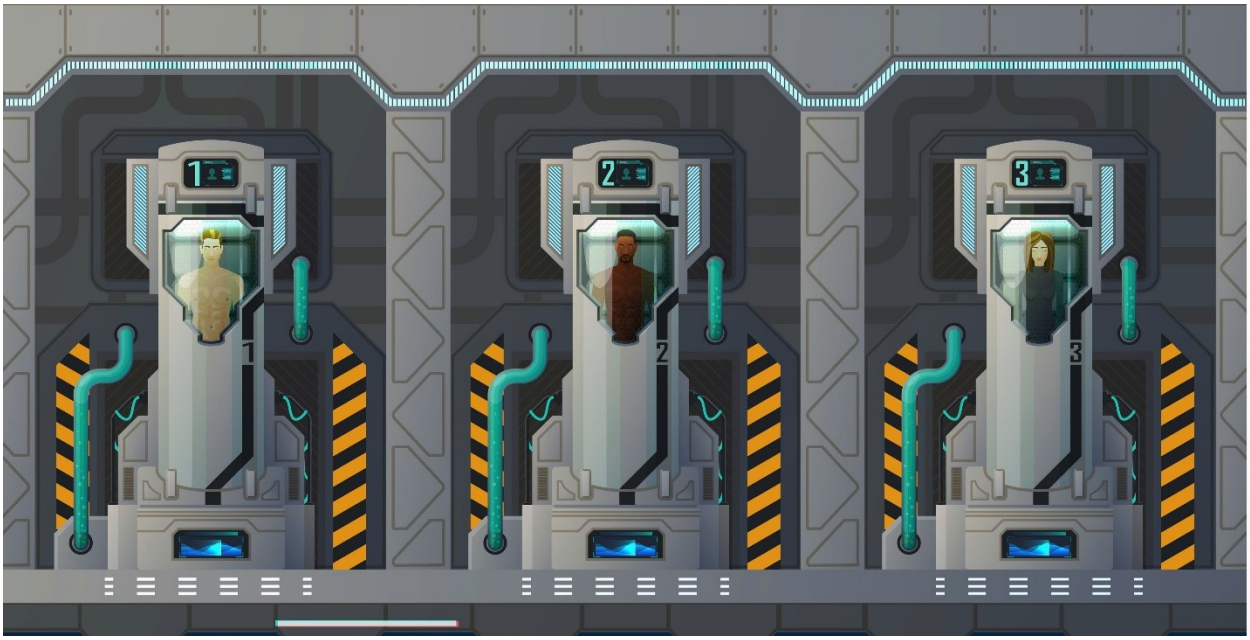
indicators in addition to a conventional total body system utility. Fracture identification and reduction success can be performed with the Bio-Sound potentially eliminating the need for bulky X Ray equipment.

A proprietary **STAT** airway management system is provided using a novel spiraling external flange configured endotracheal tube for rapid and secure facial fixation and houses an elastomeric circuitry with embedded sensors that transmit physiological information to the core CPU. The need for additional invasive procedures such as arterial blood gases and blood draws are eliminated in the case an individual needed intubation. AI controlled management of a proprietary dual balloon cuff provision alternates inflation and deflation to discourage tracheal endothelial pressure injuries. A **BioFlow** fluid management device prevents unintentional fluid mismanagement as well as regulates the negative pressure settings desired for the enclosure environment. The **BioNeb** regulates the **Bio-Atmosphere** therapeutics inside the enclosure chamber. Conventional telemetry provisions are at hand as well as pacing, cardioversion, intubation or ventilator management, and EEG capabilities and interpretation. A Rapid Sterilization Excimer Lamp is provided as well as a Surgical Lamp. An improved **Surgical Instrument Technology** is provided which facilitates surgical instrument utilization in space while decreasing the chance for unintentional injury to delicate structures in zero gravity. A novel proprietary **Pain Management Device** is introduced utilizing non-narcotic sensory therapeutics.

The proprietary negative and or positive pressure **Bio-Enclosure Cabinet** provides an airtight contagion isolation chamber with direct access care capability. An eye wash system, nosebleed management, burn management, Incision and Drainage device, and wound lavage system is provided preventing contamination of the space craft. A proprietary **VO2 Sat determination device** is provided for oxygen saturation determinations in the zero gravity and or a hemodynamically compromised crew member situation. A library of medical procedures are integrated with a video monitor display and instructional format in the case that the medical officer is debilitated. AI interpretive, diagnostic, therapeutic, and interventional software is always at hand. The core CPU provides functional interoperability between components, data analysis, medical reference libraries, and AI integration. A comprehensive physiological parameter assessment is provided with the BICU's hematopoietic, pulmonary, cardiovascular, musculoskeletal, and neuroendocrine software. The mental and emotional health of the astronaut is given special consideration considering the cohesiveness of the team and performance of the individual relies heavily on a healthy mindset.

Additional BioZone innovations include a universal rapid splinting system, a modified PAPR headgear, the **STATUS** Software that documents all pertinent

information of the mission, cognitive enhancement stimuli, a modified chest compression device designed for zero gravity, as well as stroke and Acute Coronary Syndrome detection software. A novel means for feminine hygiene is introduced to discourage PH imbalance bacterial overgrowth and the risks for Urinary Tract Infections. Even a better nail clipper is introduced to facilitate the procedure while preventing floating foreign bodies. A reproductive tract protective garment has been designed with the BioZone Project also. The space version BICU is truly a Hybrid Miracle providing numerous necessary solutions for autonomous medical care in space and we believe the BICU should become the accepted standard of medical stations designed for space travel. While early in the stages of product realization, it is the opportune time for NASA to engage with the development of the BICU.



The next of the series of BioZone Unit configurations define a **Crew Base Station (CBS)** for each astronaut, as seen above in one rendition, and encourages a promoted positive hedonic experience and craft lifestyle during spaceflight. It is here where the enjoyment of life on a prolonged mission can be procured. It is here where the astronauts will **identify with their CBS** as their own personal habitat for the mission while providing a multitude of utilities and applications. The CBS Hybrid Enclosure station will provide sufficient room for comfort, darken so that a natural circadian rhythm can be achieved, house an interactive **virtual avatar** specifically designed for the individual's nature, religion, ethnicity, and interests. It is here where the astronaut may seek 'private' neuropsychiatric treatment regarding anxiety or depression, enhance positive biofeedback, pray, enjoy the

personalized video and audio entertainment, or just enjoy some alone time in a preferred comfort control temperature environment.

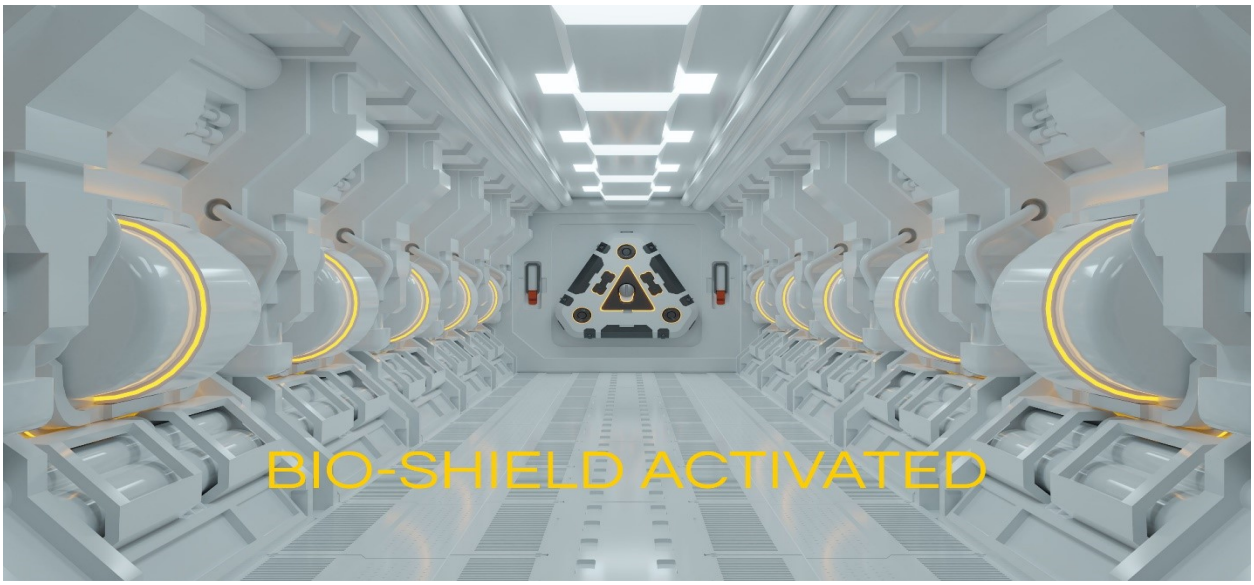
Mood lighting for Melatonin stimulation as well natural lighting to promote Vitamin D conversion is provided. Relaxing sound with a gentle influx of plant induced negative ions will encourage deep sleep after a brief session of relaxation techniques and melatonin stimulation. The CBS **sensory enhancement system** will provide ongoing sensory stimuli to promote mental acuity, focus, and alertness. Interactive health assessments may be obtained as well as procedural and learning activities. Virtual vertical orientation perception is provided as well as gravity sensation and gravity acclimation training. Pressure gradient therapy is provided in the case Neuro Ocular Syndrome or facial edema occurs as well as other **Pulmonary Health** sessions to strengthen the natural immunological protection against free radicals or prevent the potentially toxic effects of dust inhalation from extravehicular excursion or chemical exposure inside the craft. A private enclosure chamber for 'personal hygiene' is provided by the CBS to attend personal conditions such as constipation, vertigo, or urinary retention, for example. Snoring and or acquired sleep apnea may be mitigated within the privacy of one's own CBS chamber without disrupting others by use of the proprietary BioZone **Nasal Stimulation Device**. A methane emission filtration device is provided due to the predictable methane accumulation in an enclosed air system such as within the space vessel subjected to prolonged space travel. Of course, radiation exposure treatment will be provided by the BioZone CBS enclosure chamber by means of the **BioNeb Therapies**. The CBS will additionally provide a negative pressure isolation and decontamination means if the need arises.

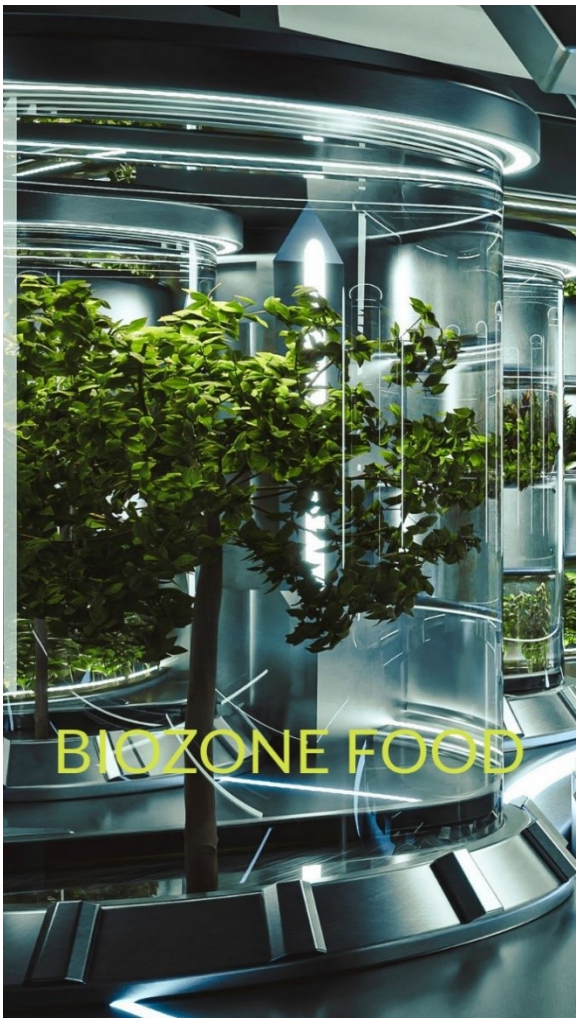
The space saving configuration of the BioZone Unit has been well planned for the limited space available inside the space craft. The unit may be designed for vertical or horizontal orientation within the cabin with consideration of a given overall

cylindrical design configuration of the space craft body and crew section. The BioZone CBS has a central elongated planar section which houses the device intricacies of the apparatus and is pivotable to the vertical or horizontal orientation desired. There is therefore a Side A on one side of the planar section and a Side B on the opposite side of the planar section. Once again, the two sides are rotatable according to the desired utilization. Either Side A or Side B will function as the BioZone provision for the **Crew Habitat** which may be shared on a rotational basis such as in the case of having a roommate. The design would permit the astronaut occupant to be able to rotate the CBS so that the occupant is facing the hull of the space craft with a partition blocking the awake and noise center section of the craft. In this manner a better circadian rhythm experience may be provided as the enclosure portion of the CBS would provide the necessary darkness and sound suppression. Of course, on the opposite 'work side' of the CBS, other occupants could be performing duties without interfering with the sleep cycle of the astronaut within the enclosure component. The pulmonary health and other provisions of the BioZone enclosure are designed to function during the down time or sleep cycle of a crew member.

A **Bio-Shield** has been integrated with the CBS unit wherein a radiation protector shield can be activated to encircle both sides of the BioZone Unit. In the case of detected solar or galactic events that would endanger the lives of the astronauts the crew could rapidly return to the confines of the CBS until the danger has subsided. Given such events could be extended, the BioZone amenities would provide suitable amenities to await the end of the event. A food and water provision could

easily be configured into the CBS for such instances. In this fashion the vulnerable food growing station as well as the microbiome stations will be protected from radiation as well. The following rendition illustrates one version of the Bio-Shield activated for the safety of the crewmember temporarily residing inside the CBS.





The work side of the CBS becomes the **Mission Function Station** (**MFS**). It is the MFS side of the BioZone that provides for food growth, experimentation, water production, oxygen and CO2 management, the Microbiome System, for example. The CBS can therefore operate in an X,Y, and Z axis stationed in any preferred lateral aspect of the space craft body's cylinder section. The CBS pivotable and rotatable design can provide a living and working environment arrangement upon the surface of Mars given gravity is provided by the planet. Additionally, any one BioZone Unit may be pivoted and secured away from the hull toward the midline of the crew cabin therein providing a crew eating or meeting surface.

The operational aspects of the working side of the CBS including the water production, food growth, microbiome management, experiments, etc. is beyond the scope of

this narrative. The BioZone CBS Module provides for a neatly organized crew and workstation with a space saving configuration temporarily or permanently housing a multitude of applications. This design is space saving since separate sleep quarter zones are no longer necessary from the awake section of the cabin. The CBS units themselves are detachable and may be relocated to a separate Mars structure accompanying the space craft or constructed either on the surface or below the surface requiring only a power source to regain function.

To further encourage positive attitude and mental wellbeing of the astronauts the BioZone Project has developed a highly specialized food supplement called **'Packsters'** which 'reconstitute' in the astronaut to a complete menu of preferrable meals individualized prior to launch. The essence of the packster concept arose from research Vertu Medical Technologies performed on patient 'cravings' subsequent to bariatric surgery reducing the intake capacity in order to lose weight. The research performed indicated that it was the absence of the smell and taste of the food that no was longer suitable for the anatomical modifications that bothered them most. The packster concept was then initiated to create a reconstitute able food supplement that would fill this craving void without adding caloric intake and weight gain. A bariatric patient would be able to enjoy the taste and smell of a prime rib packster, for example, helping to satisfy the satiety center of the hypothalamus as well as the emotional aspect of the individual.

In the space packster version whereby caloric intake is actually encouraged, a broad variety of nutritional support may be combined in a food element that is space saving consideration. The reconstitution of the food matter and thus bulk of the food occurs starting in the duodenum providing the necessary bulking agent which is healthy for the gut motility and a desirable probiotic environment. We believe the packster meal may provide a mitigant solution to the space saving aspect of space travel planning as well as the emotional needs of the astronauts.

Additionally, the food production and microbiome station of the BioZone will generate much of the necessary ingredients to create the packsters on board the craft. To explain this, we take this increased bulk benefit in the GI tract to promote healthy gut mobility. The increase in excretion bulk is managed through a BioZone System **Microbial Fuel Cell** wherein a proprietary mix of organisms liberate electrons as they respire which in essence create a microbial battery. The energy created by the fuel cell actually runs the process and has spare energy that may be transferrable. Once the fuel cell depletes the excrement bulk to a maximum extent, the remaining substance has been purified and may be used as fertilizer for the food growing process and microbiome system. Water is also produced and purified in the same fashion utilizing the process. Wastewater becomes reusable therein supplying a different source of water than that what is preloaded, extracted from

the air inside the craft or from capture through any extracapsular hydrogen capture device. The purification of the excrement and urinary system water also produces reusable energy and the fuel cell can actually be modified to rid the excreted content of pharmaceuticals and chemicals which could accrue unintentionally as result of prolonged space missions.

Note the bulking agent of the packster project is standardized and the taste and smell of the end resulting food is created in a desirable selection by the crew utilization of the packsters. The bulking agent is specifically printed or molded to correlate with the preferred food. The packster meal supplementation thereby not only addresses the natural memory cravings and satiety center, but it also benefits the mental and emotional aspect of space saving food production and consumption on a prolonged space mission. We believe the BioZone process warrants further investigation.

The final space version BioZone Project application is the novel exercise system created with consideration to available space and weight on board a space craft. The BioZone System therein provides a hybrid provision exercise apparatus titled the **'Gauntlet'.** This highly required '**total body training**' system is comprised of a proprietary exercise apparatus that in one application utilizes Lenz Law applications as well as Tensioner mechanics. The astronaut is provided a weight stack free exercise device that generates as much resistance as the user is able to and or desires to work against. The mechanism is based on speed of movement generating resistance instead of a weight of an object. A serial lighting provision and speed of light progression along the predetermined yet adjustable range of motion of the intended exercise correlates to the amount of resistance. In this case the user simply dials in the desired resistance and then moves the resistance component at the pace of the moving light. The inability to keep up with the predetermined calculations of speed of movement and resistance correlates with a user losing strength and muscle mass. The AI integrated CPU analyzes the loss of strength and adjusts the training routine for the individual. This provision along with the **BioSound** muscle mass determination method previously discussed will prove to be a light weight, space saving exercise and biokinesiology evaluation system for space craft.

The preferred alternative version of the Gauntlet utilizes magnetic and electromagnetic resistance and is configured into an all-in-one space saving exercise apparatus that provides essentially every known conventional training maneuver known to the exercise equipment industry. The following proprietary and provisional patent petitioned Gauntlet Strider is demonstrated in the 3D CAD Simulation. To view the simulation, click in the middle of the image.

BioZone Gauntlet Trainer

Note that this rendering only uses the Tensioner means of resistance and the advanced Gauntlet version uses a hybrid cooperation of the tensioner as well as a bilateral housing magnetic and electromagnetic resistance means illustrated in figure 2.

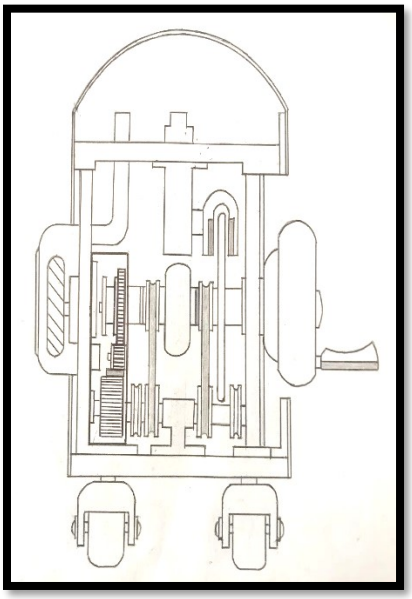


Fig. 2. Lateral Housing Mechanism

In this version the lateral housing resistance mechanisms utilize a tensioner component housed in the elliptical circulating track component, which is directly communicating with a pinion drive shaft, that houses a ferrous plate that rotates with an actuator driven neodymium magnet series, then continues to communicate

with a clutch mechanism and subsequently terminates with the optionally activated electromagnetic resistance mechanism. The lateral housing mechanisms provides the three resistance mechanisms with a lateral dimension of only 10 inches. The lower pulleys provide accessory utility with provided modified Smith cage and cable training components.

The Strider Gauntlet CAD Movie is shown without the modified Smith cage component which provides the essentials of the vertical lifts and the cable components providing all known cable training maneuvers. The totality of the preferred embodiment of the Gauntlet Training System has easily pin attached components that provide the following exercises: treadmill, elliptical, rower, sprint trainer, cross country skier, stair climber, crossover stride trainer, leg press, all Smith cage universal exercises such as squats, deadlifts, cleans and clean and presses, military presses, and all cable exercises such as bicep and triceps work, high pulls, deltoid and lats, and a full series of abdominal work maneuvers, for example, but not limited to. VMT believes the light weight and compact Gauntlet trainer is the total body solution for prolonged space flight.

An alternative utility for the Gauntlet System is the provision of physical therapy and rehabilitation of injuries acquired during a mission such as the Mars mission. The entire Gauntlet System is integrated with the BioZone Core Unit CPU providing preestablished specific individualized training sessions and AI facilitated in flight adjustments according to the loss of muscle mass known to occur. The mechanism of the Gauntlet training apparatus produces yet another means for additional reusable power to supplement the conventional powering elements of the craft. Again, VMT is in an MVP early-stage product realization with the Gauntlet prototyping and offers an opportune timing for NASA to collaborate with the project.

Finally, and unfortunately a provision has been included to convert any BioZone Unit into a morgue. In one application liquid nitrogen is infused into a space suit housing the remains of an astronaut. The BioZone can then be configured to provide the enclosure chamber capable of filtering any tissue necrosis or microbial gaseous discharges that may leak from the astronaut’s suit over time.

In summary, the BioZone Project presents an exciting opportunity to investigate the potential utility and integration of the numerous system solutions, mitigations, and provisions with space travel. It is an extremely satisfying experience for Vertu Medical Technologies to be able to offer our technologies for consideration for with VMT the sky is certainly not the limit.