Prototyping project

Group Members

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What our product achieves

1. Assist in the rescue after environmental disasters, mostly:
    - Earthquakes
    - Tsunamis
    - Cyclones
    - Hurricanes
2. Traverse through rubble and find survivors. It maps out terrains.

Snakebot's target group

- Governments
- First responders
- Non-government organizations (Doctors without borders, etc…)

How Snakebot works

Snakebot uses a combination of sensors to pinpoint the location of a victim. Using IR and Temperature sensors to produce a heat map of an area that allows the user to identify points of danger. In addition, it incorporates a speaker and microphone to directly communicate with a survivor, allowing the user to assess their condition.

Mechatronics (initial ideas)

- Snake designed in parts - main segments and joints between them
- Segments are cylindrical and house either electronics or ballasts for submerging underwater
- Ten segments in total, varied ballast control for submerging different parts at different times (i.e. tail with antennae at the surface, while head with sensors deep underwater)
- Rollers on all four outer sides of the segments for crawling-like movement
- Joints are the connections between segments using a rolling ball design, controlled by four hydraulic pistons on four sides
- They are covered by a flexible material to allow bendability, but also to protect the pistons from dust and water

What our product consists

- PIR, IR (Temperature sensor)
    - Used for detecting people under rubble by heat radiated
- Sound sensor
    - Used for sonar for underwater purposes, such as seabed mapping
- Light + Camera
    - Useful for navigation underwater
- GPS, Barometric pressure for altitude
    - Used underwater
- Gyroscopes in all segments
    - Used for orientation awareness
- Microphone and Speaker
    - Used for communication with the victim
- Antenna for radio communication

Snake physical design constraints and boundaries

- Waterproofing may be hard, especially in the joints between segments, same for dust proofing.
    - This could be fixed by the aforementioned isolation around every joint, meant to protect the hydraulic pistons. It can be connected to the segments' endings and sealed with a strong adhesive. The parts where adhesive will be used are the rubber elements (with the function of protecting the pistons) and the main exoskeleton of the robot.
- Cannot bend very much (depending on the size of segments).
    - The snake should be able to make a circle as a flexibility requirement. The ends should be able to touch each other. This is one of the goals to ensure enough flexibility during operation.
- Small segment housings do not allow a lot of room for electronics.
    - This can be calculated precisely once the size of every PCB is determined. They can be spread across multiple segments (or joints) to distribute free space, and therefore weight. This is as opposed to having everything in the head.
- Ballasts for submerging take up further valuable space.
    - Joint spaces can not be used as ballasts as the joints will lose flexibility.
- Combined design for rubble/dust and water traversing makes components for each action exclusive.
    - For example, the water ballasts are of no use in a dry environment.

How Snakebot will meet user's needs:

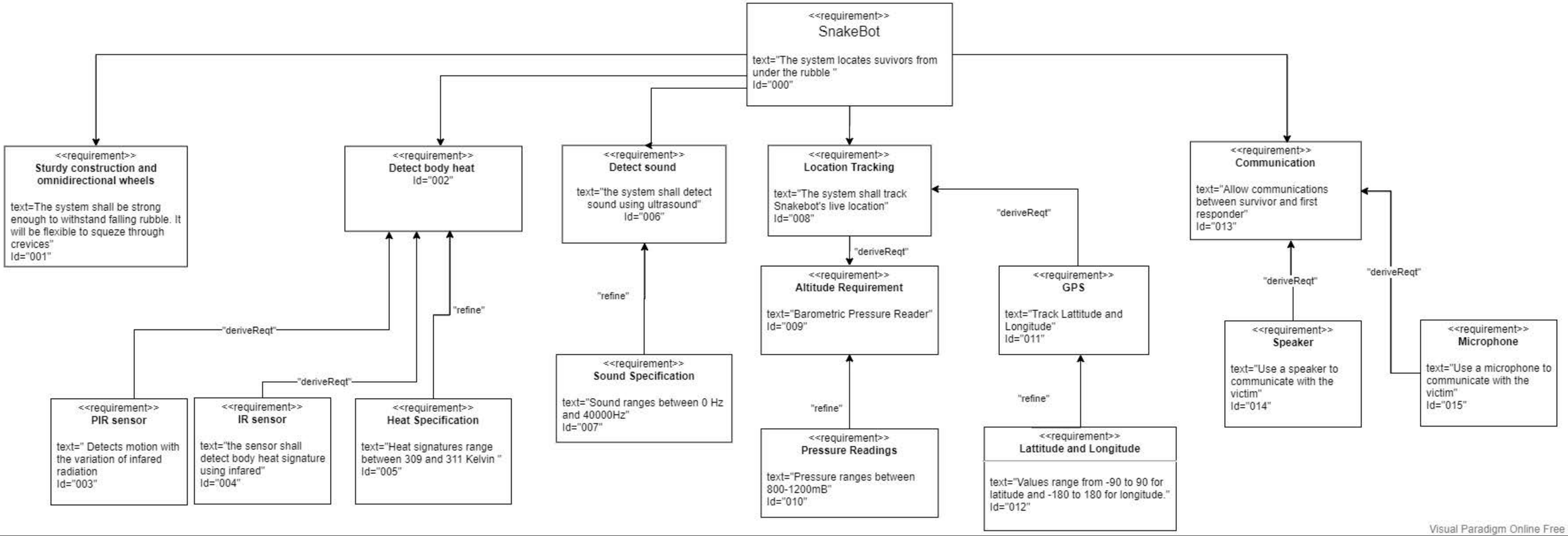
- Track and Locate survivors faster than typical first responder time
- Access hard to reach areas under rubble and water
- A communication link between victims and first responders
- Determining the state of the survivors
- identify points of danger

Our product is targeted towards government bodies and front line entities. It is made to function in high danger areas which are sealed off to the general public.

The bot consists of individual components that are connected to a central microcontroller. The system architecture is Embedded. The components with their required constraints and boundaries are stated in the SysML Diagram.

The system achieves the user's requirements by traversing the environment through its flexible and sturdy design. It can detect, locate and transmit the victim's location directly to the user.

req [Requirement Diagram] SnakeBot



#	Task	Short Summary	Todo+Deadline	Done + Finishing date	Todo	Done	Name
1	Stakeholders involved	Analysis and Interpretation of stakeholders	11/04/21	11/04/21		Done	Dani
2	Constraints and Boundaries	Description of constraints in relation to design choices	12/04/21	12/04/21		Done	Cris + Kaloyan
3	Task Delegation	Breakdown objective into small tasks, allocate according to members' strengths	11/04/21	11/04/21		Done	Shehroz
4	SysML	Map requirements to SysML	12/04/21	12/04/21		Done	Shehroz + Hanan
5	Design	Discussion of design	11/04/21	12/04/21		Done	Shehroz + Hanan + Dani + Cris + Kaloyan
6	Requirement Specification	Identify and Record Requirements	12/04/21	12/04/21		Done	Shehroz + Hanan + Dani
7	Proof-reading	Check the document for errors and grammar	12/04/21	12/04/21		Done	Dani