



Watchdog

An Intelligent Procedure Tracker



A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including multiple modules and large solar panel arrays, is clearly visible against the dark background of space and the blue curve of the Earth's horizon. An orange geometric shape, resembling a large triangle, is overlaid on the left side of the image, partially obscuring the station and the Earth.

Development **Team**

Ryan Lorica Lead | Computer Vision

Jiacheng Liu PCB | Peripheral Interfacing

Leo Mei PCB | Peripheral Interfacing

Jingzhe Chen UI | Algorithm Design

Anzhe Ye UI | Algorithm Design

A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including its large solar panel arrays, is clearly visible against the blue and white horizon of the planet. A large red diagonal shape is overlaid on the left side of the image, containing the text.

Introduction Motivation

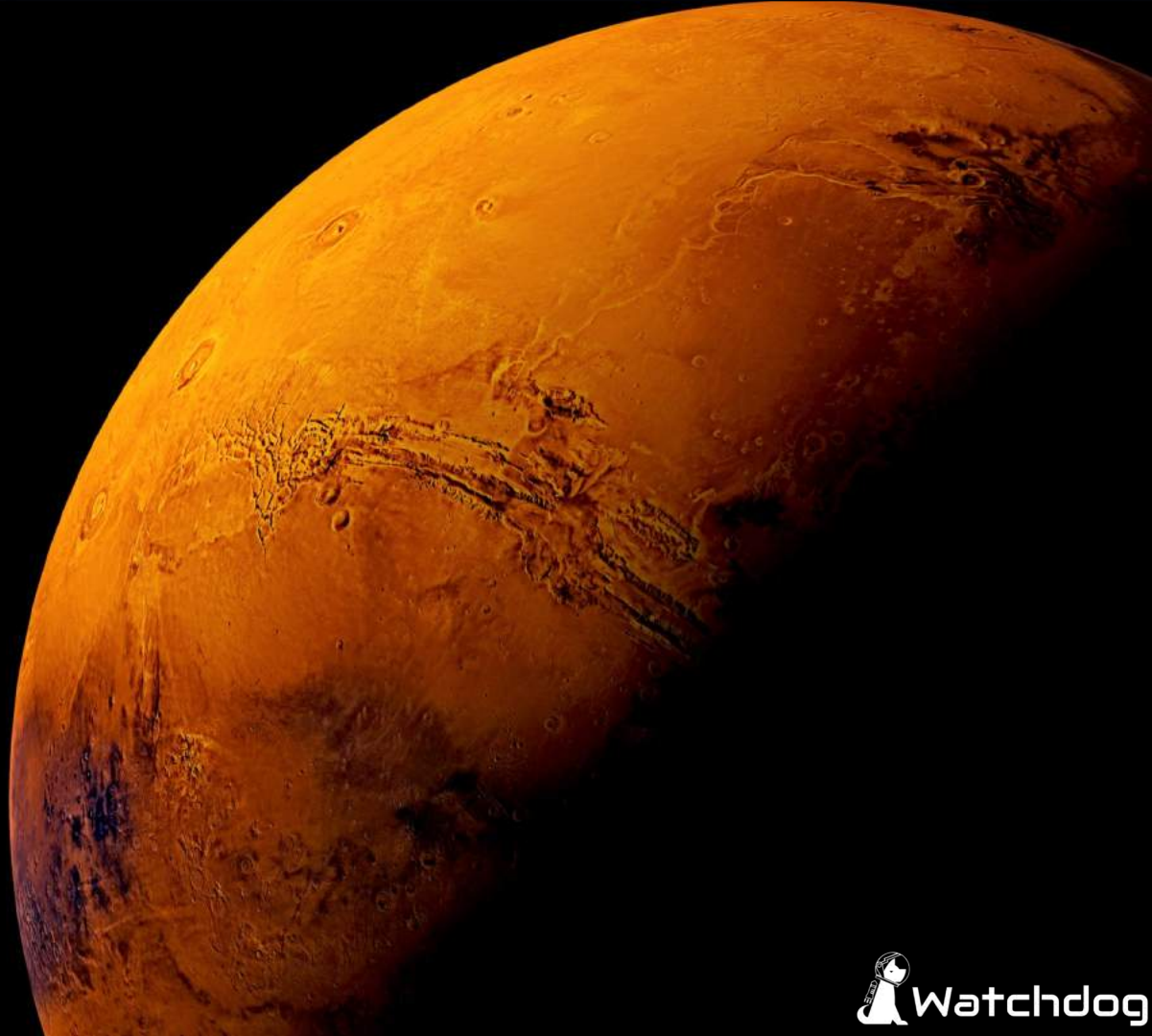
IKEA JOB INTERVIEW



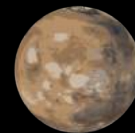




Motivation

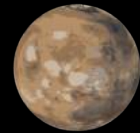


Motivation



Motivation

Up to 40 minutes...



Motivation

Goal

Goal

To verify an astronaut's accuracy to standard
operating procedure

A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including multiple modules and large solar panel arrays, is clearly visible against the dark background of space and the blue curve of the Earth's horizon. A large blue diagonal shape is overlaid on the left side of the image, containing the text.

Introduction **Solution**



Computer Vision powered Body-mounted camera

LCD display with 3D-printed case

NFC tags embedded tool

PCB embedded glove(Motion/Tool detection)

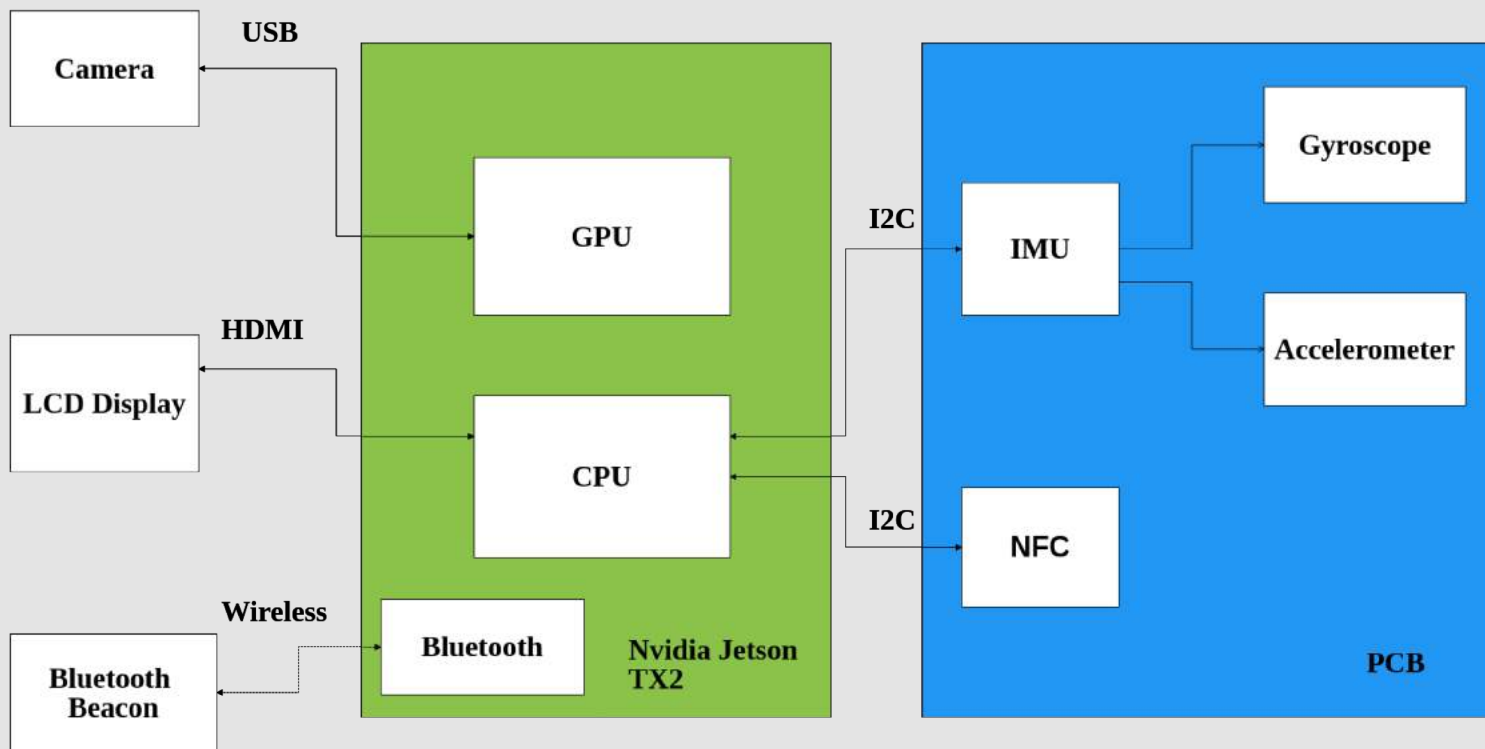
TX2 and power supply inside the backpack



Solution

A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including multiple modules and large solar panel arrays, is clearly visible against the blue and white horizon of the planet. A large yellow diagonal shape is overlaid on the left side of the image, containing the title text.

Hardware **Overview**



Hardware

Block Diagram

Nvidia Jetson TX2

- ARMv8 (64-bit) Multiprocessor CPU Complex
- 256 core Nvidia Pascal GPU
- Power Requirement: 5.5 V - 19.6 V
- Interfaces: I2C, HDMI, USB, Uart, SPI
- Connectivity: Bluetooth, WiFi



- Powerful On-board Computer

Hardware

Processor

Bluetooth Beacon (Transmitter)

- One - way Bluetooth Low Energy signal transmitter
- Range of transmission: 1 m (expected)
- Localization
- Embedded in marker

On-Board Bluetooth Unit (Receiver)

- On - board Bluetooth Version 4.1
- Custom function to translate Beacon signal to distance



- Onboard Bluetooth Receiver



- Beacon

Camera

- Logitech C270 HD Webcam
- Interface: USB
- Record videos of objects



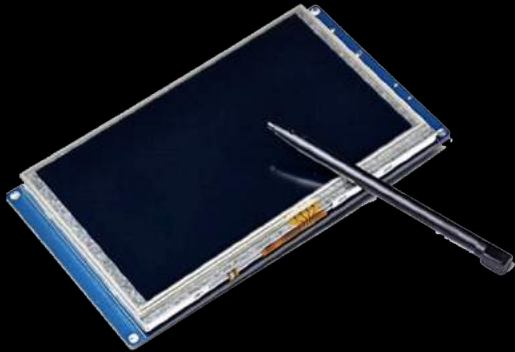
- Neural Network powered Computer Vision

Hardware

Sensors

LCD Touch Screen

- 5 inch LCD touch screen
- Power Requirement: 5 V via Micro - USB
- Interface: HDMI
- Display tasks and errors



- Wrist Mounted Touch Screen LCD

Hardware

Sensors

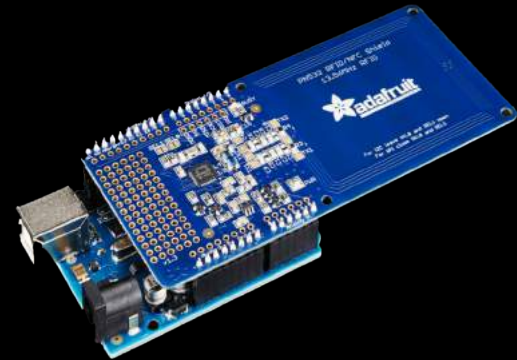
Inertial Measurement Unit

- BNO055
- 9 Degree of Freedom
- Memory - mapped addressing to specify sensor
Allowing for reading specific data
- Interface: I2C
- Accelerometer & Gyroscope
 - Analyze data to determine hand movements
such as hammering and etc.



Near Field Communication

- PN532
- Range of transmission: 10 cm
- Interface: I2C
- Recognize a unique tag when it is closed to the chip
- Detect current using tool
 - NFC chip embedded in glove,
 - tags embedded in tools





- Hand Orientation and Motion Tracking Glove



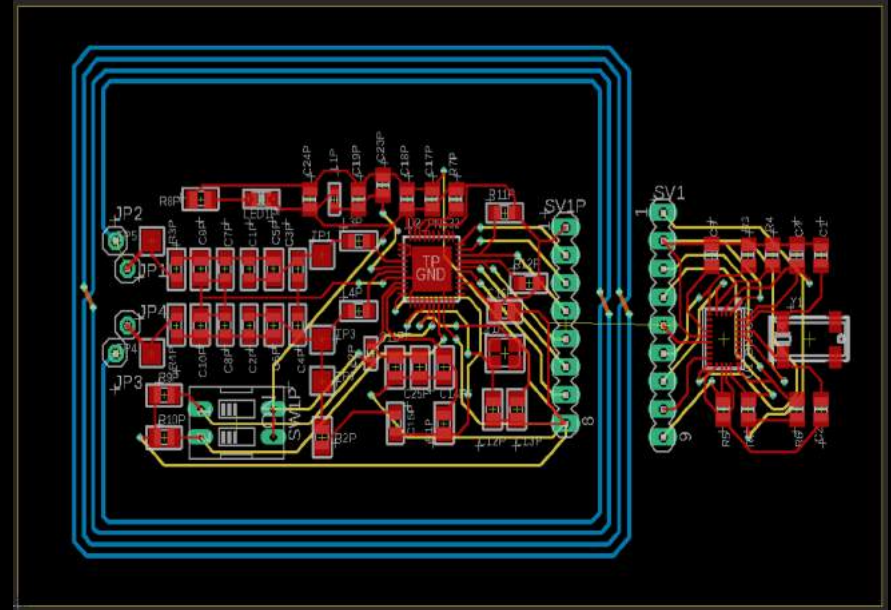
- Tool Detection and Identification Glove

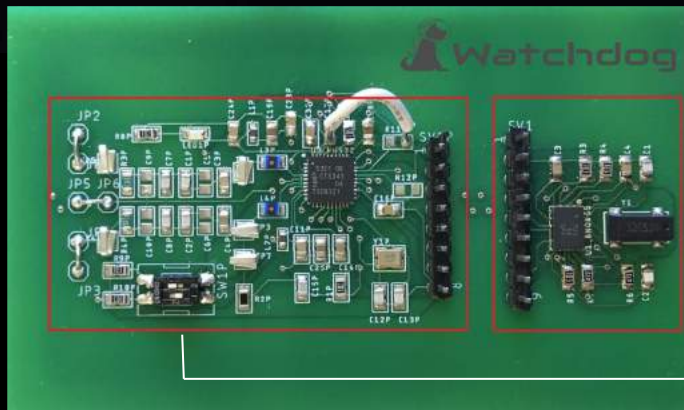
Hardware

Sensors

Printed Circuit Board

- A combination of NFC and IMU
- Challenges
 - Minimize the size
 - Design and tune the antenna
- 4 layers PCB
 - 1st layer: SMT components
 - 2nd & 3rd layer: internal connections
 - 4th layer: NFC antenna





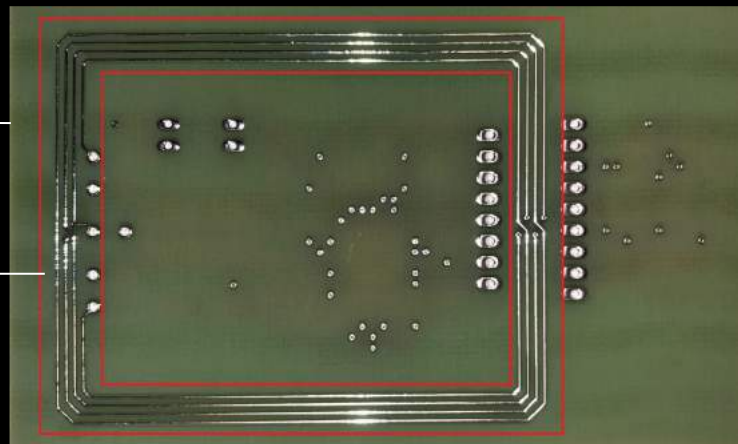
→ Top Layer Plane

→ Inertial Measurement Unit

→ Near Field Communication

Bottom Layer Plane ←

Antenna ←

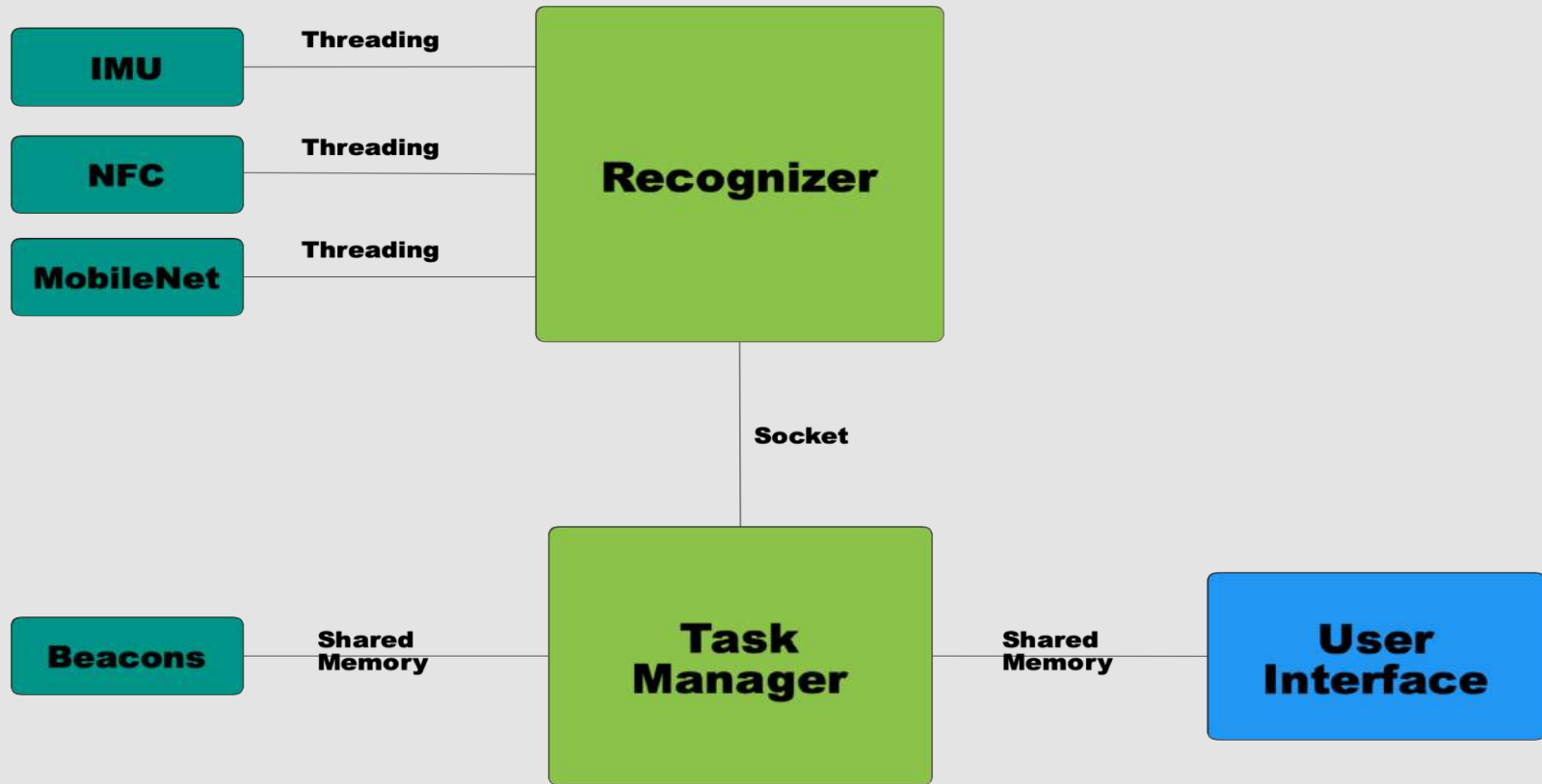


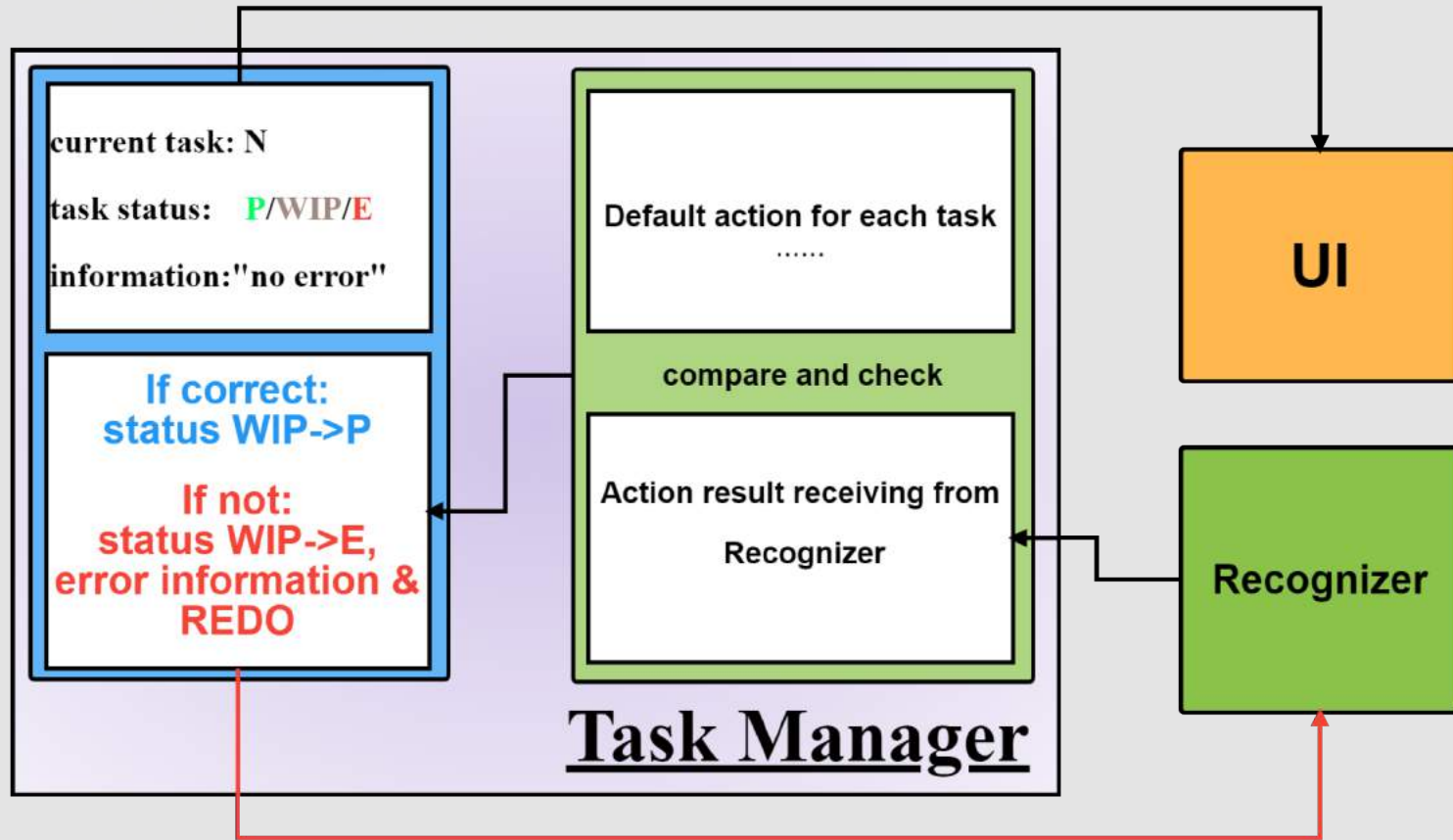
Hardware

PCB

A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including multiple modules and large solar panel arrays, is clearly visible against the dark background of space and the blue curve of the Earth's horizon. A large purple diagonal shape is overlaid on the left side of the image, containing the text.

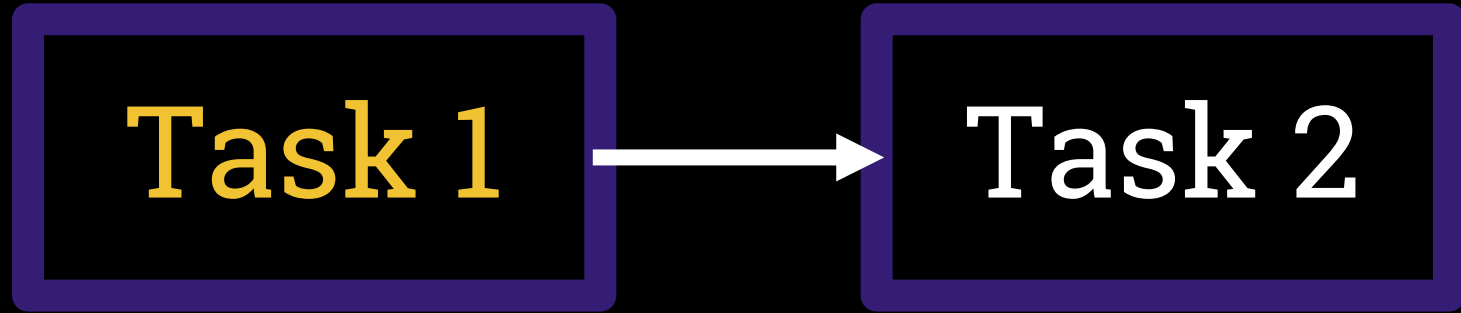
Software **Overview**





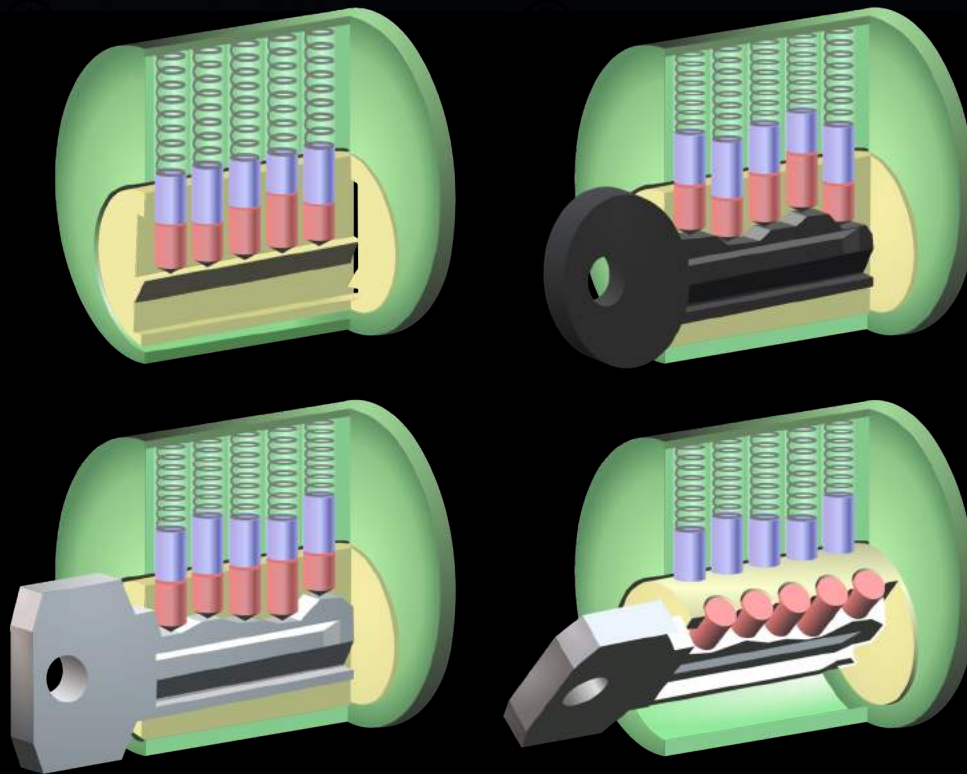
Action Recognition Algorithm

Software



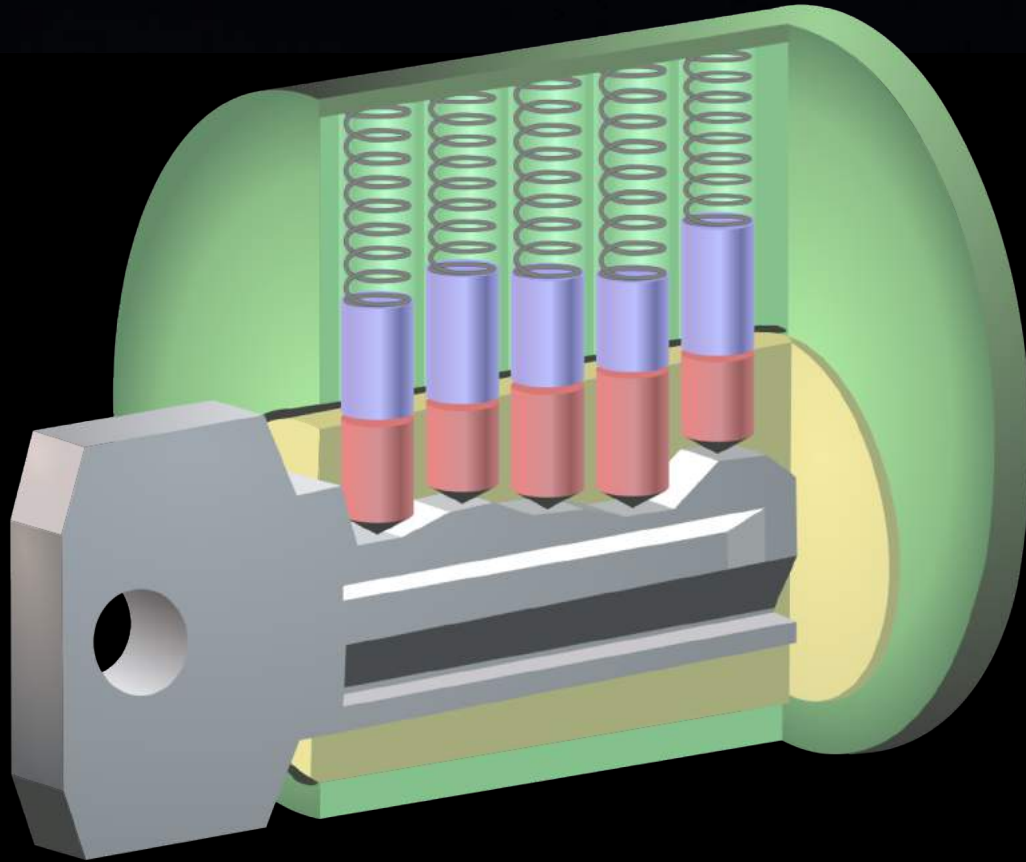
Software

Recognizer



Software

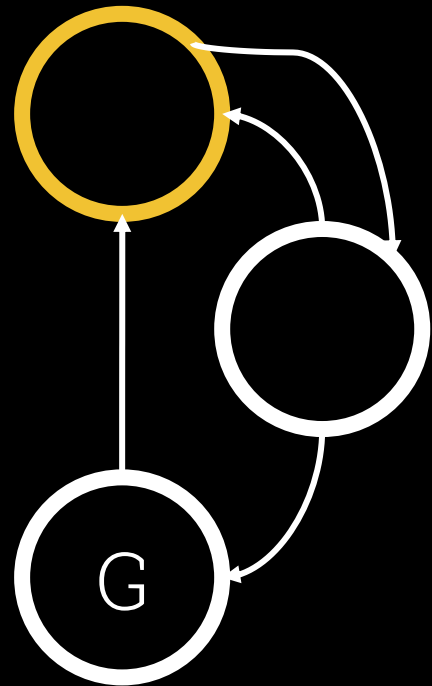
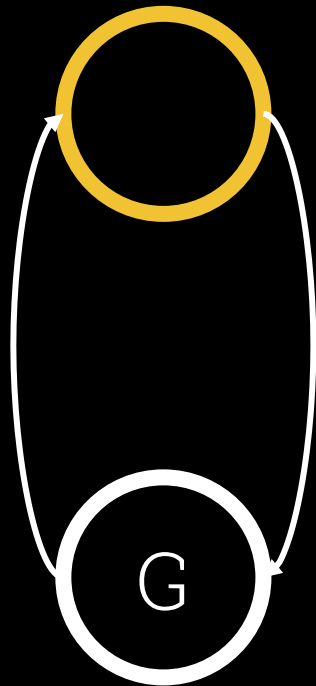
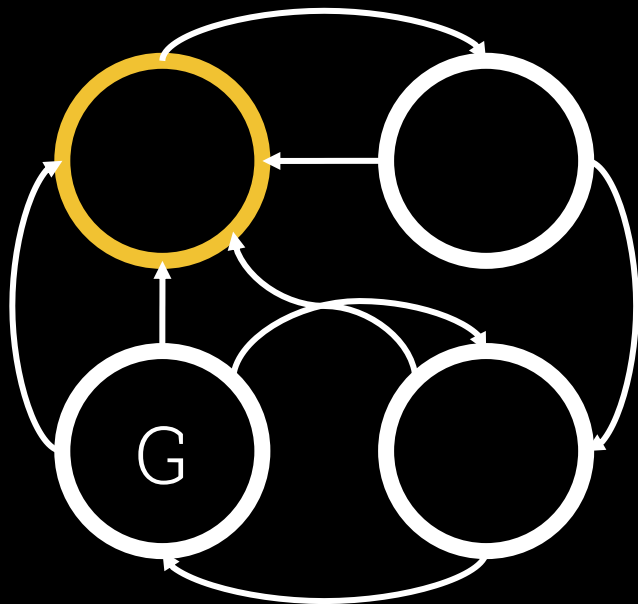
Recognizer



Software

Recognizer

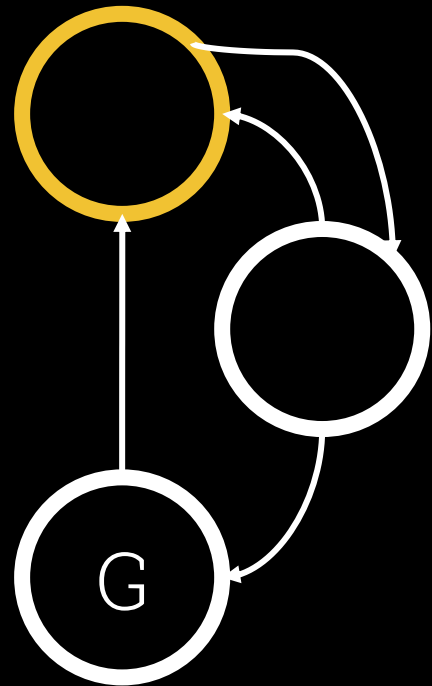
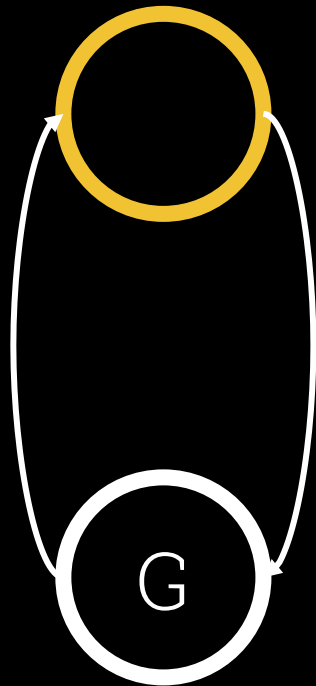
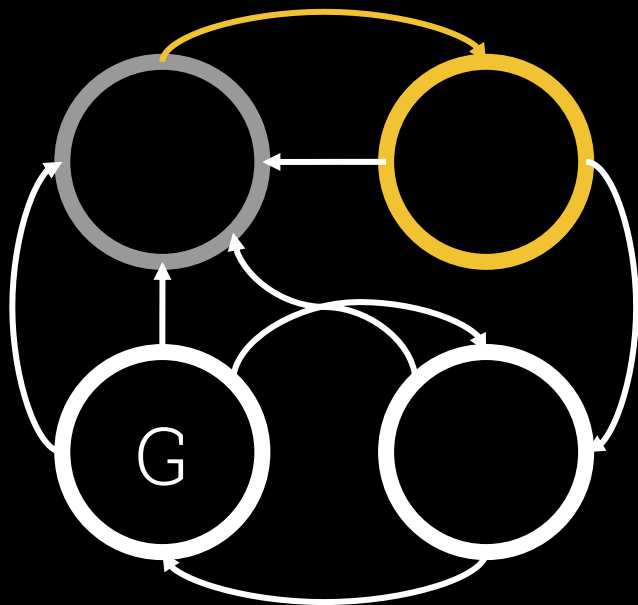
Task 1



Software

Recognizer

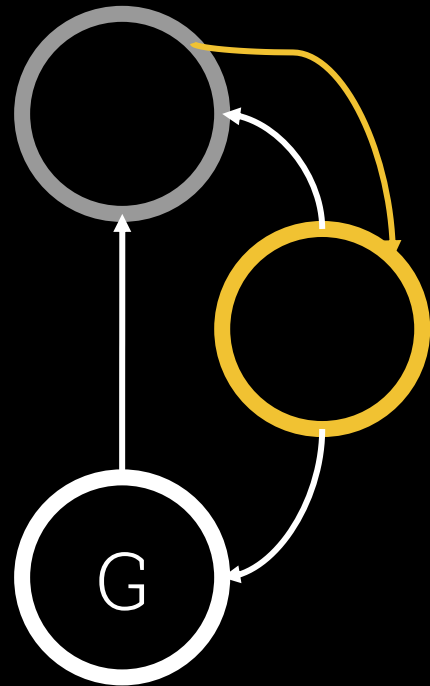
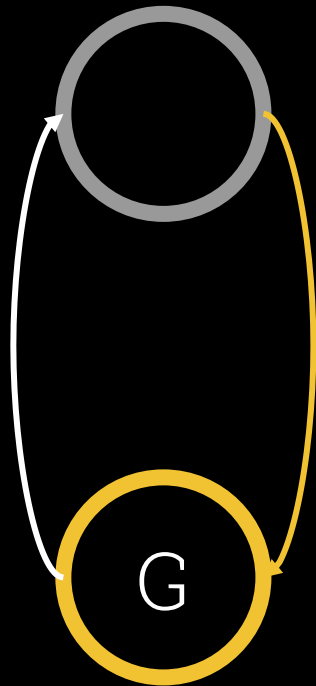
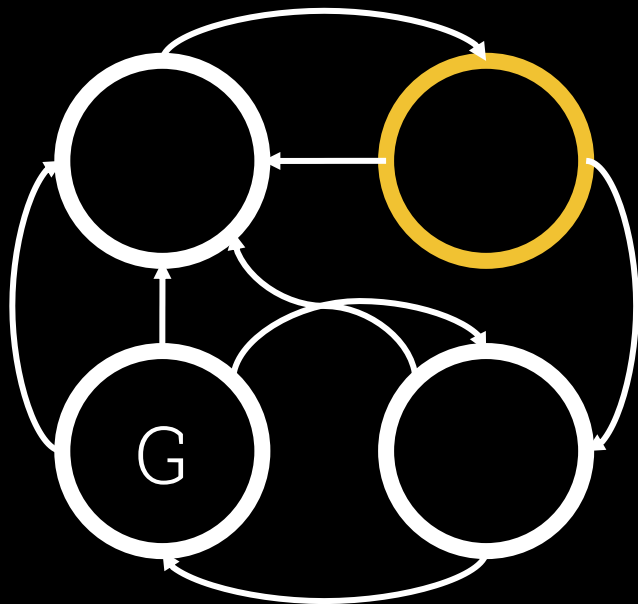
Task 1



Software

Recognizer

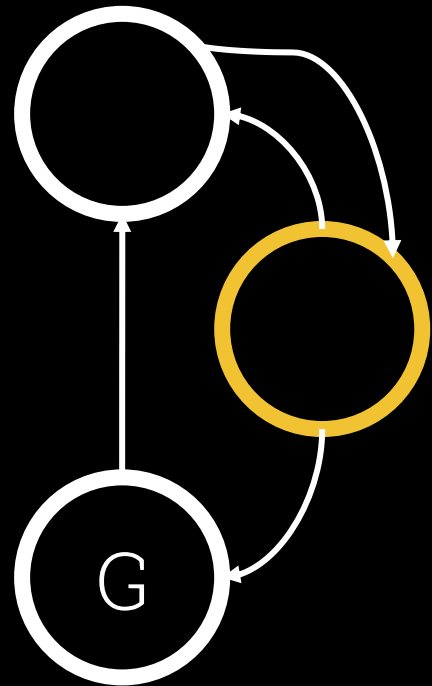
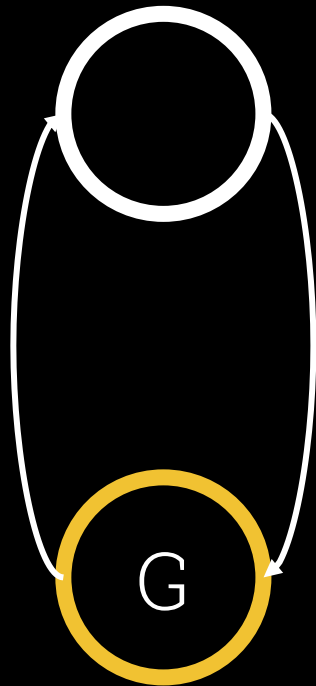
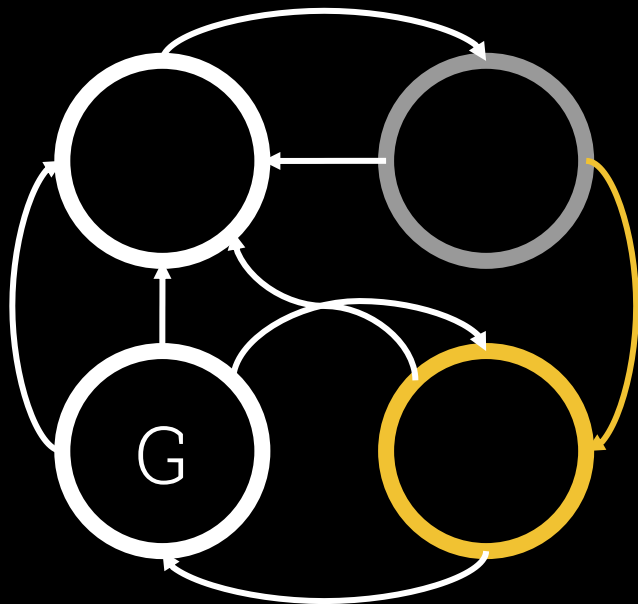
Task 1



Software

Recognizer

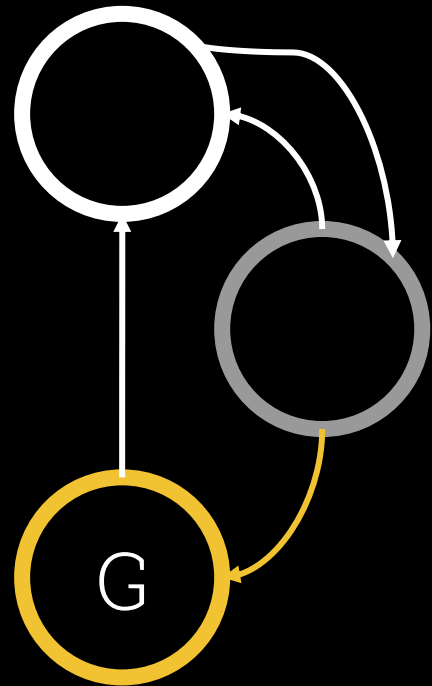
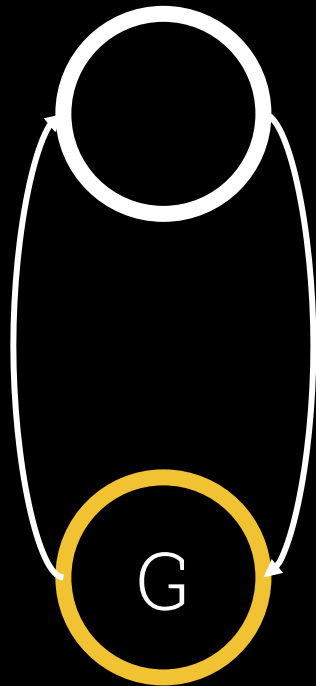
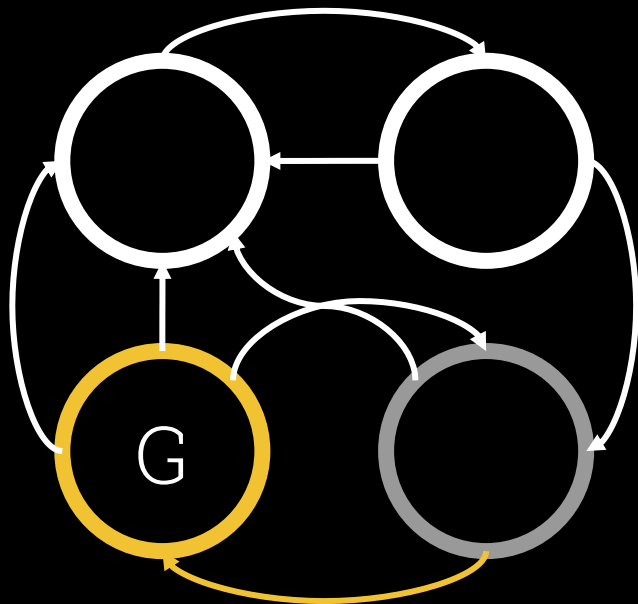
Task 1



Software

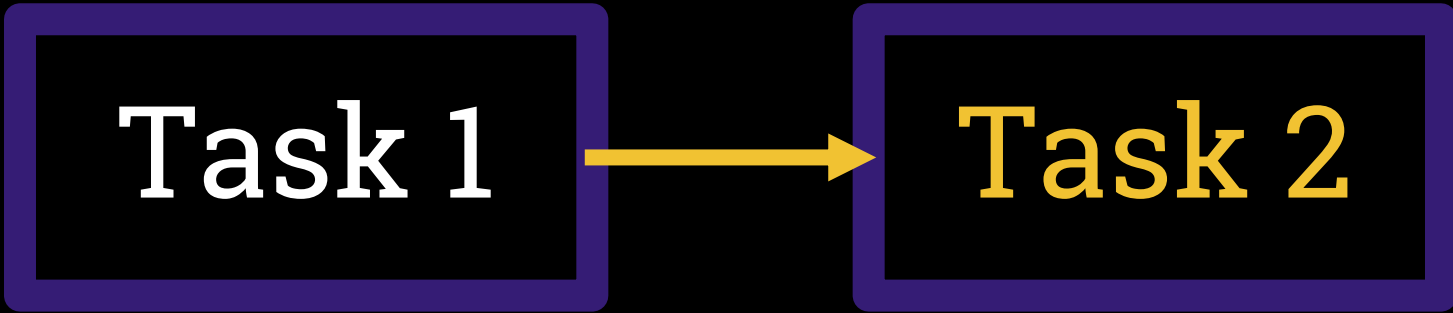
Recognizer

Task 1



Software


Recognizer



Software

Recognizer

Current Task

<p>Task 1</p> <p>Place the plastic marker or approach the site as near as possible...</p> <p>(click for more details)</p>	<p>Completion Check : </p> <p>Working Status:</p> <p style="color: green;">Done</p>
--	--

Go to another interface with task details

Green -- "Done"

Grey -- "Waiting"

Yellow -- "In-progress"

Red -- "Warning"

To switch task:

- Click "previous" or "next" button to the adjacent task.
- Click "task list" to another interface so that the user can select one task and go to that task.

Current Task Detail:

1. Use the body camera to search samples;
2. Use the body camera to identify those target samples;
3. Use the hammer to collect some samples.

Back



Congratulations!
You have finished all tasks!

OK

The End

Back

Review

Check

Task 6

Take some samples using the hammer...

(click for more details)



(click for details)

Completion Check :



Working Status:

Warning

IMU signal: NOT MATCHED

OK

previous

task list

next

- Task detail interface (upper left)
- Main interface, when working status is warning, indicates user's action is out of accord with that described in task.(upper right)
- The final interface (lower left) allows user to review each task and check the progress.

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Demonstration **Video**

Task Flow Chart

1. Place the plastic marker and approach the expected site.



2. Lay down the stick on the ground.



3. Take pictures of the stick on the ground.



4. Use the probe thermometer to measure the temperature of target point.



5. Use the Barometer to measure the air pressure of target point.



6. Use the hammer to take some samples.



7. Leave the current position and go to the next position.

Sample Tasks

Demo Video



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and

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