Watchdog
An Intelligent Procedure Tracker
NASA
UCSB

Development

Team

Watchdog

Members

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

Watchdog

Introduction

Motivation

Watchdog

Watchdog

Motivation

Watchdog

Motivation

Watchdog

Motivation

Watchdog

Up to 40 minutes...

Motivation

Watchdog

Goal

Goal

To verify an astronaut’s accuracy to standard operating procedure

Introduction

Solution

Watchdog

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

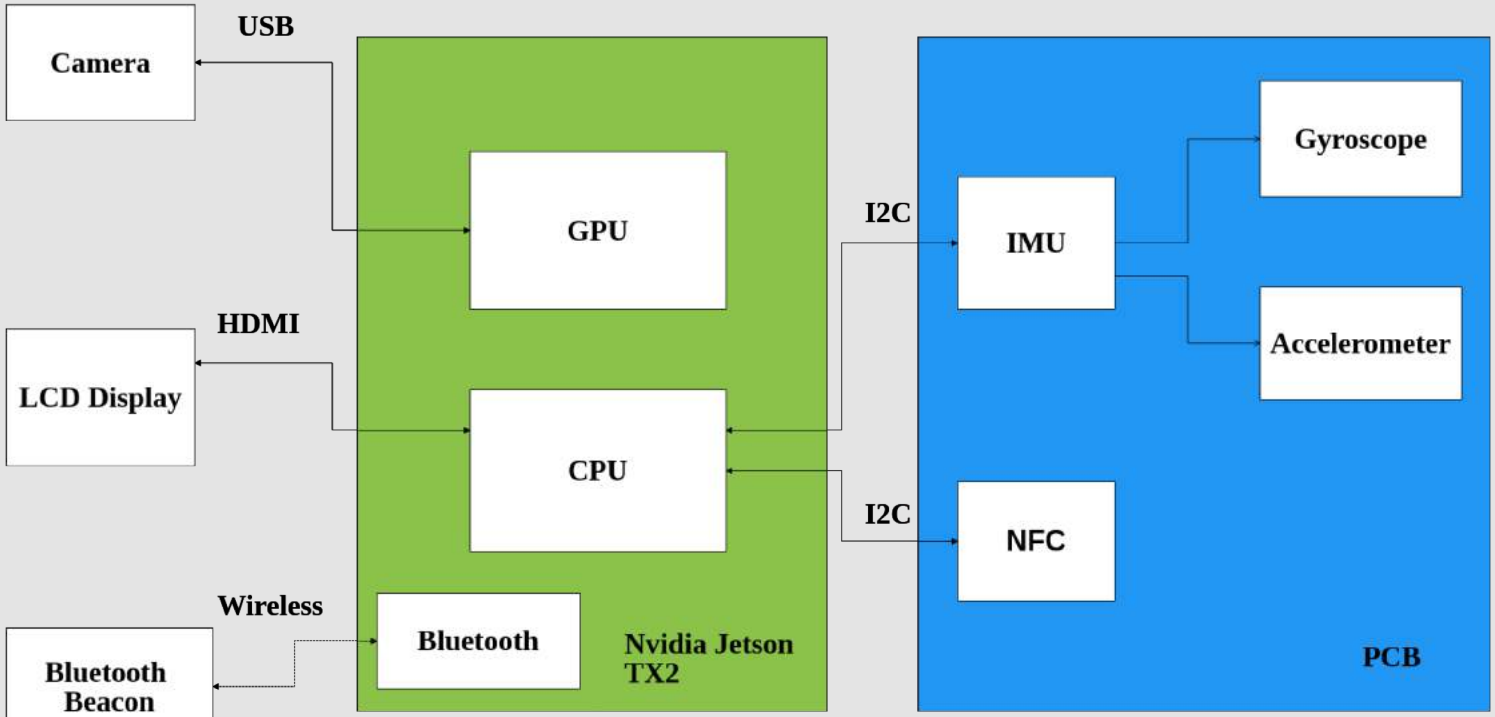
Solution

Watchdog

Hardware

Overview

Watchdog



Hardware Block Diagram

Watchdog

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

Watchdog

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

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Camera

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

- Neural Network powered Computer Vision

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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

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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.

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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

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- Hand Orientation and Motion Tracking Glove

- Tool Detection and Identification Glove

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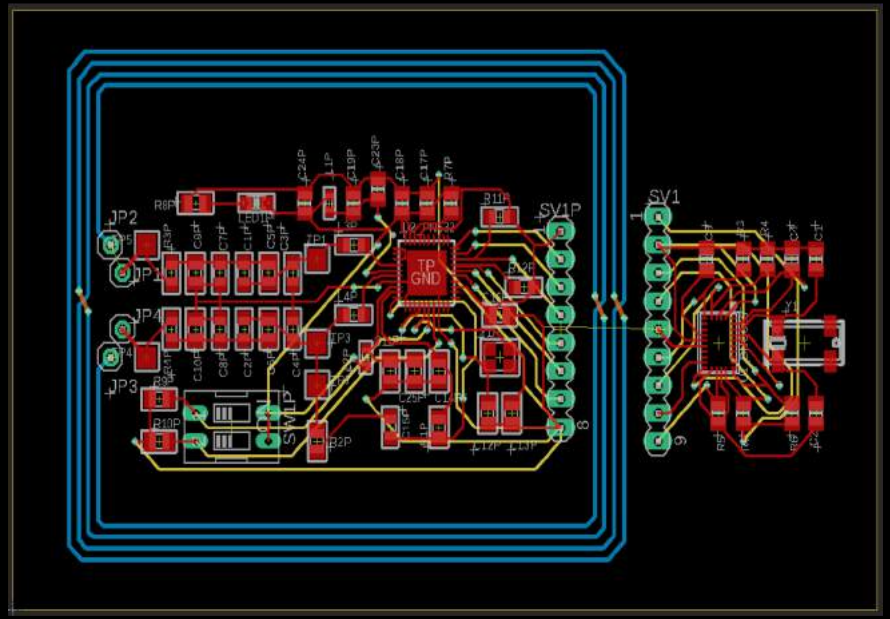
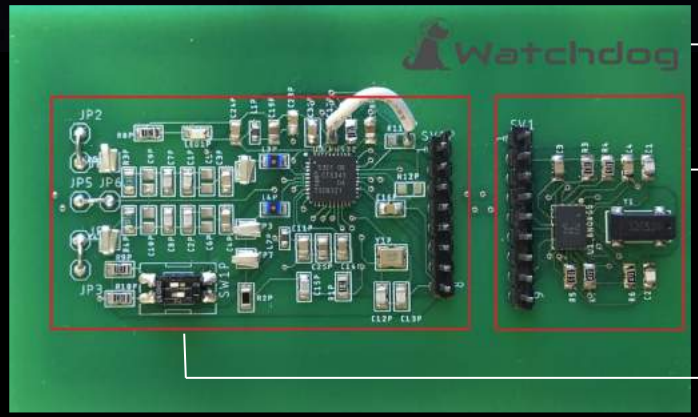
Printed Circuit Board

- 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



Watchdog



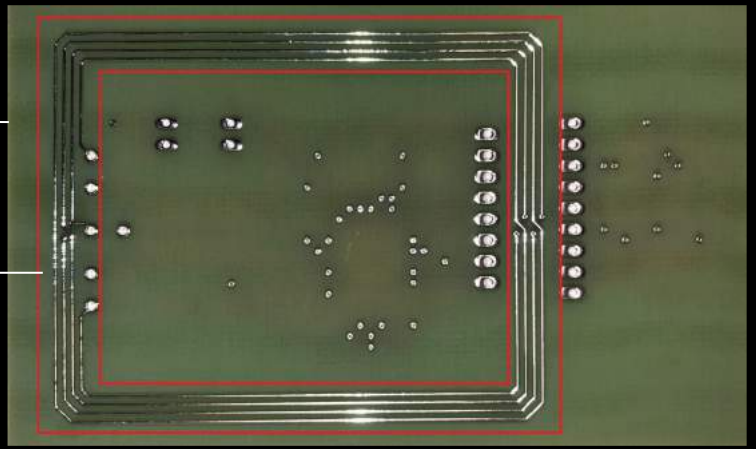
Top Layer Plane

Inertial Measurement Unit

Near Field Communication

Bottom Layer Plane

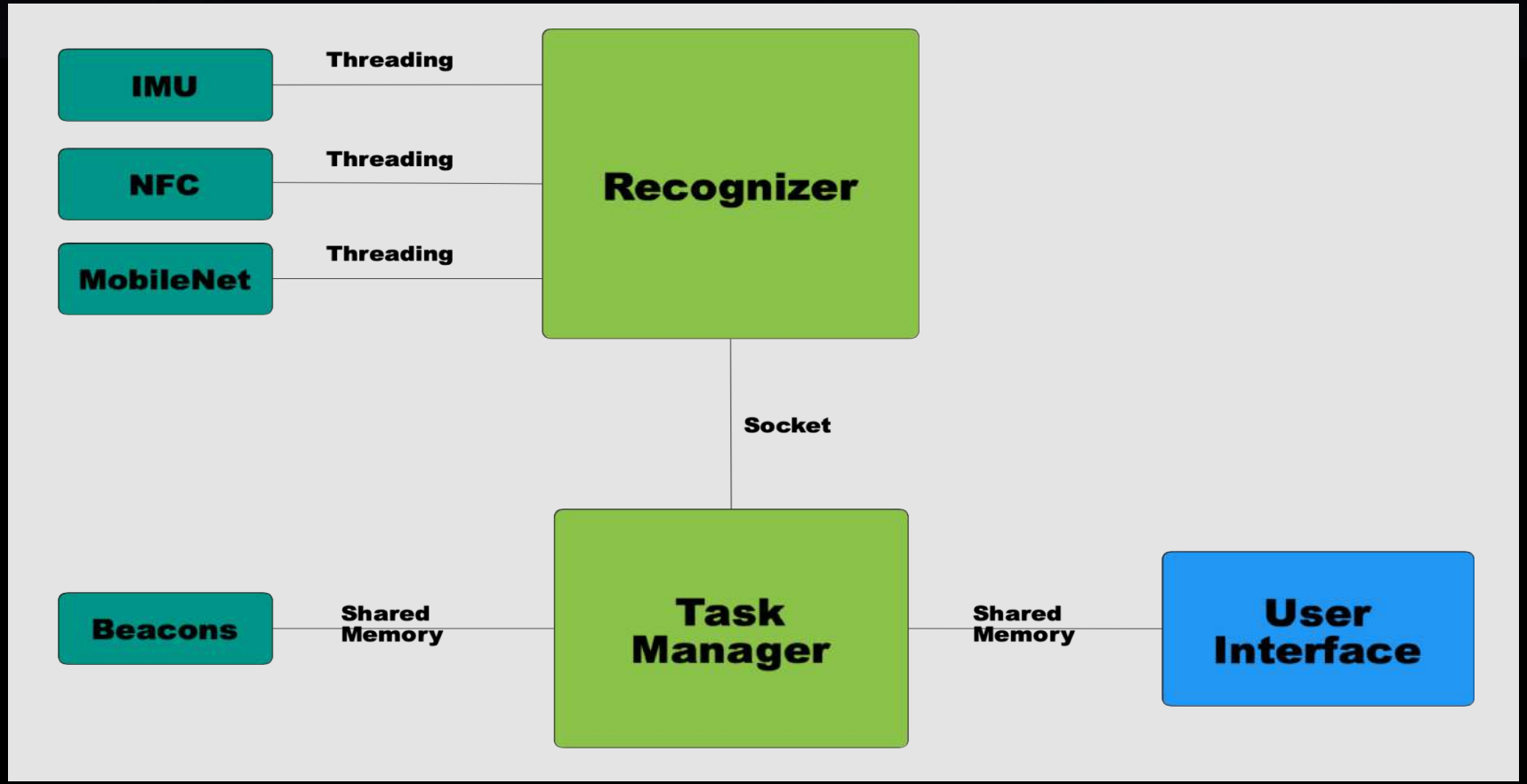
Antenna



Software

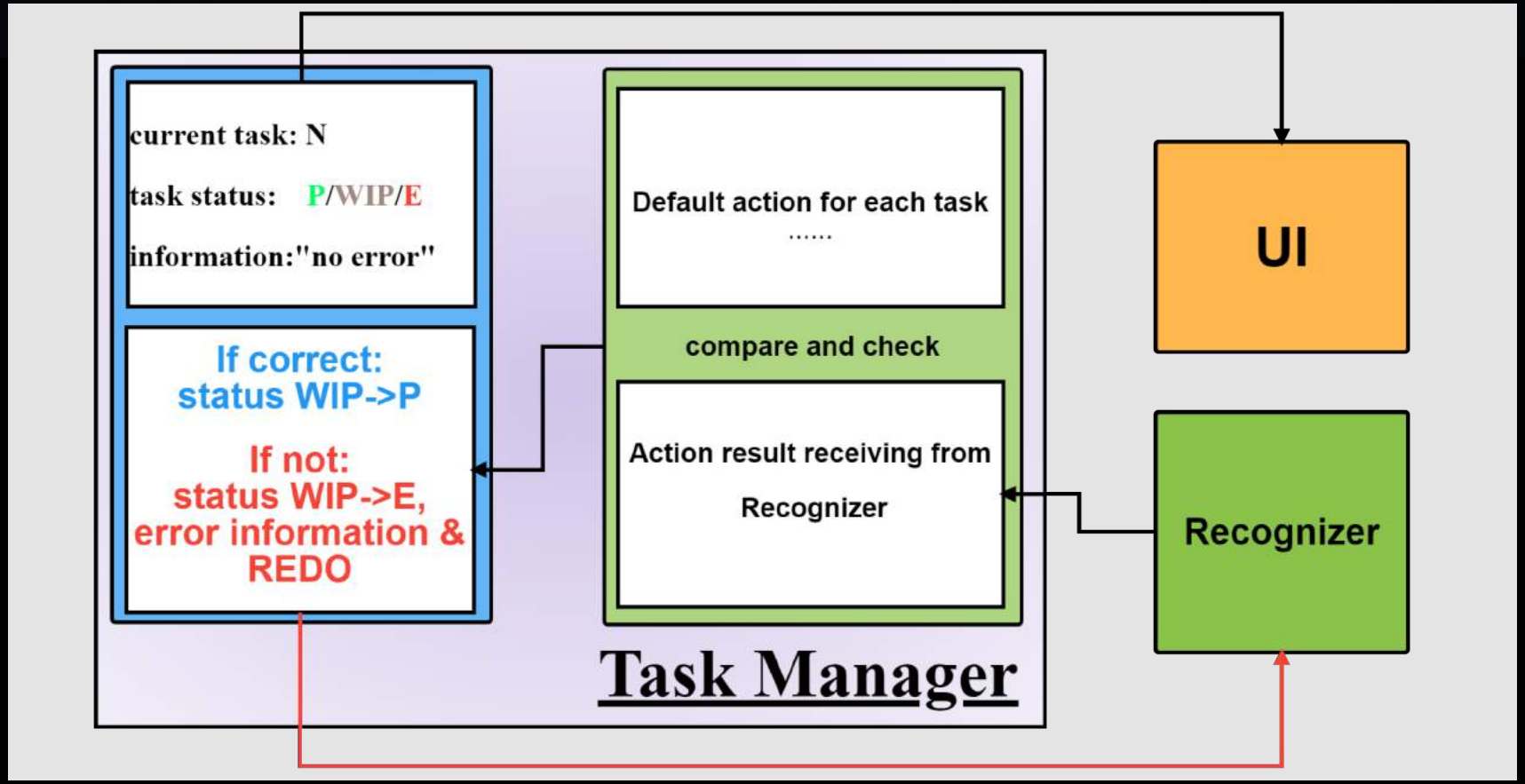
Overview

Watchdog



Software Block Diagram

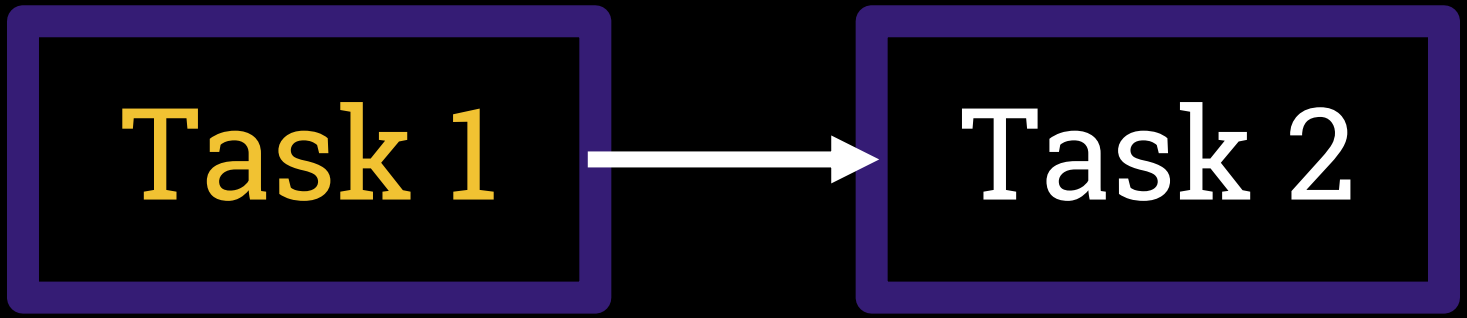
Watchdog

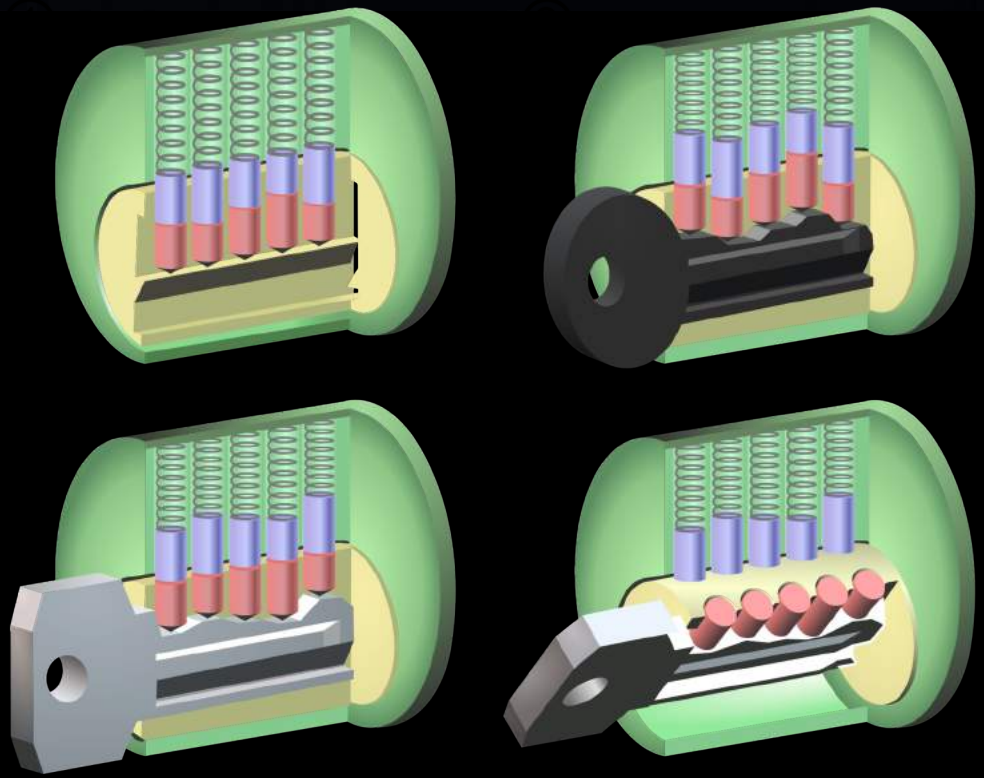

current task: N
task status: P/WIP/E
information:"no error"
If correct:
status WIP->P
If not:
status WIP->E,
error information &
REDO
Default action for each task
.....
compare and check
Action result receiving from
Recognizer
Task Manager
UI
Recognizer

Action Recognition Algorithm

Software

Watchdog

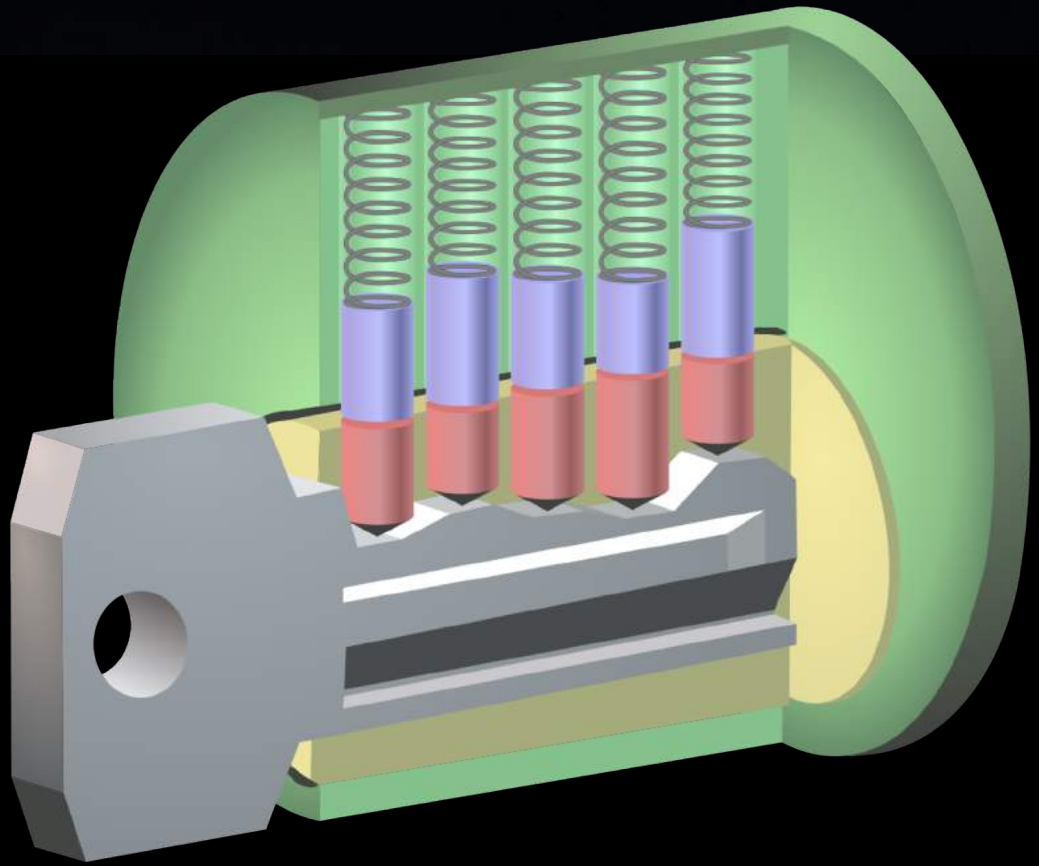

Task 1
Task 2



Software

Recognizer

Watchdog



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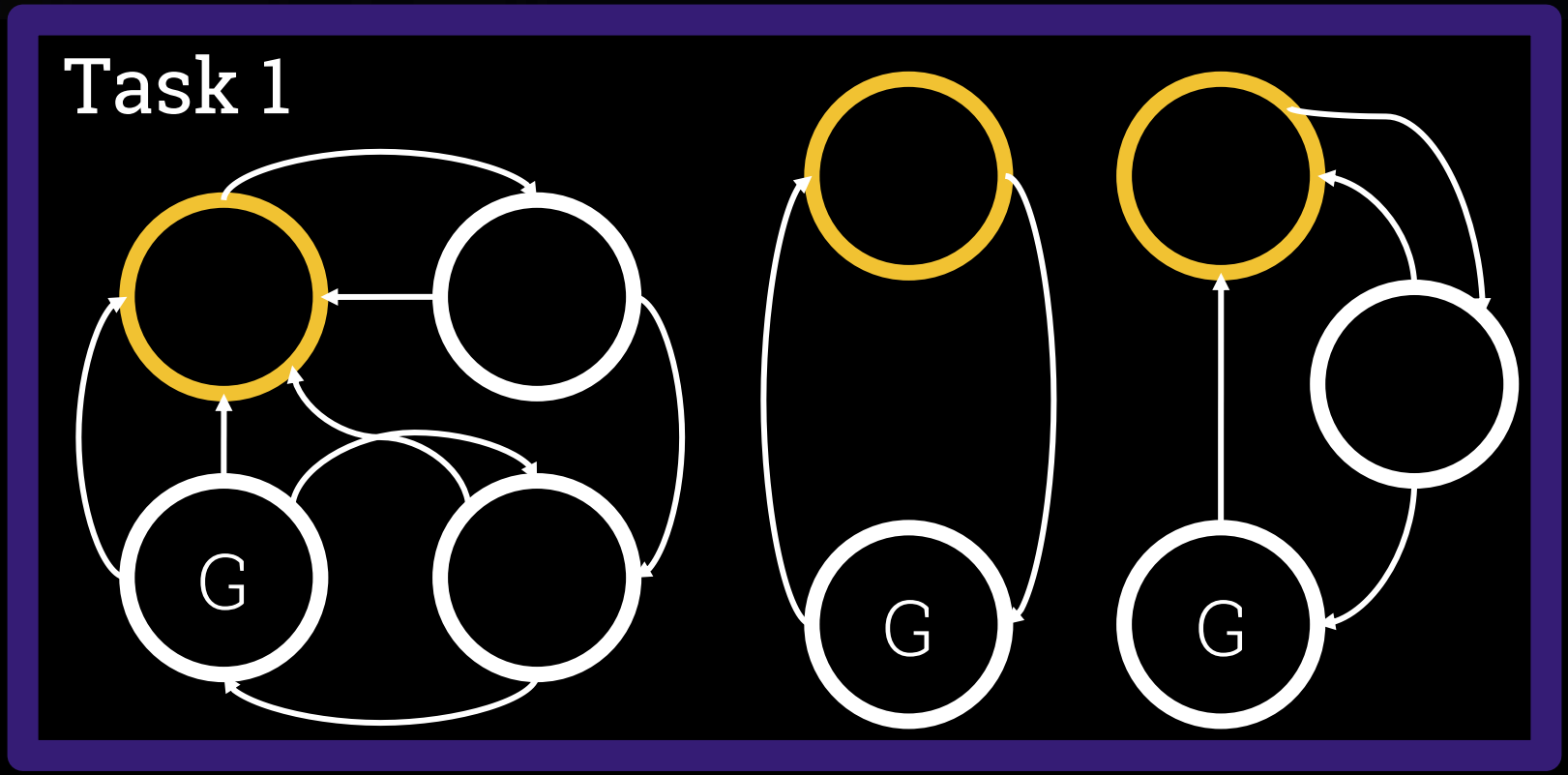

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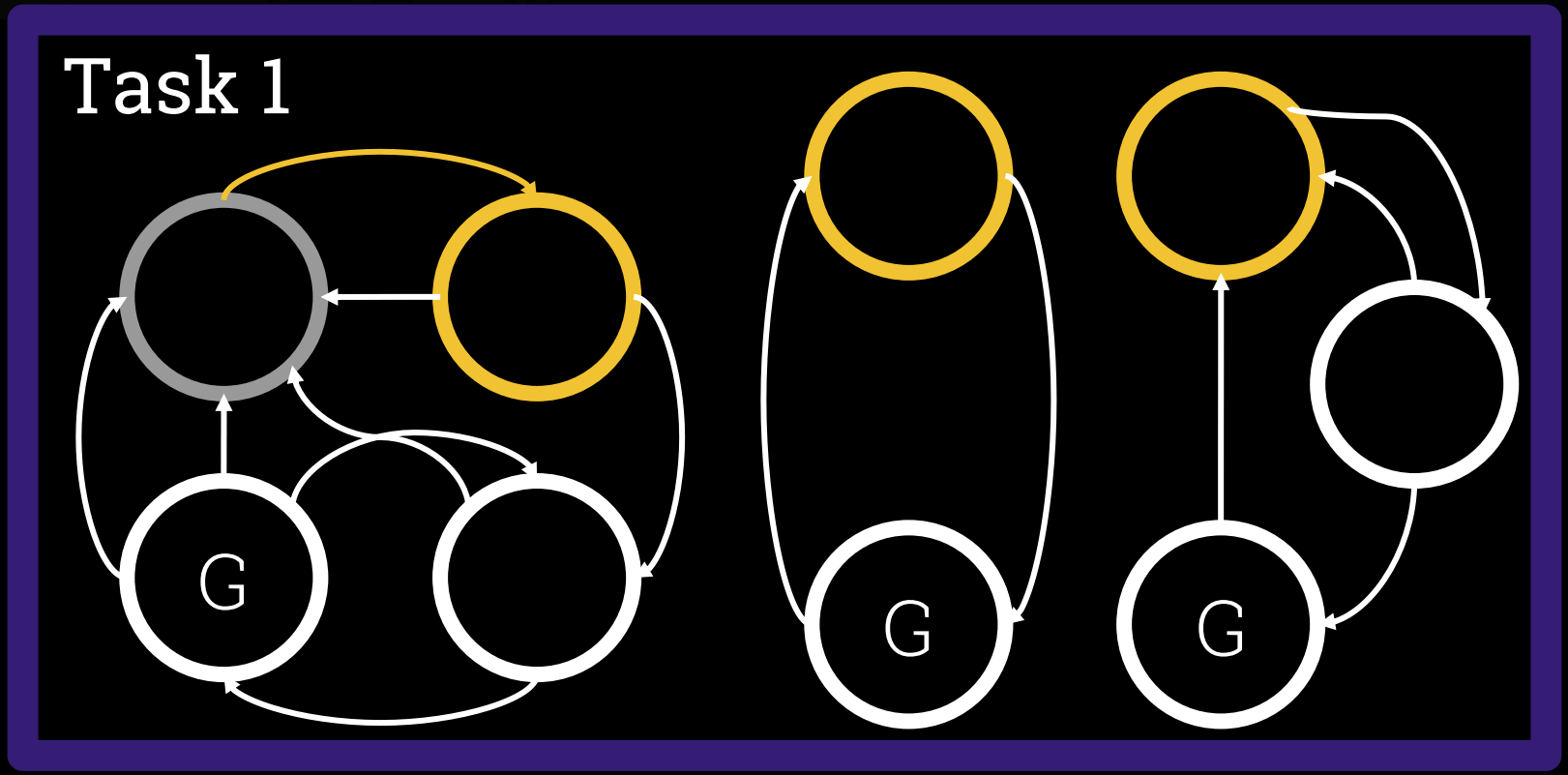

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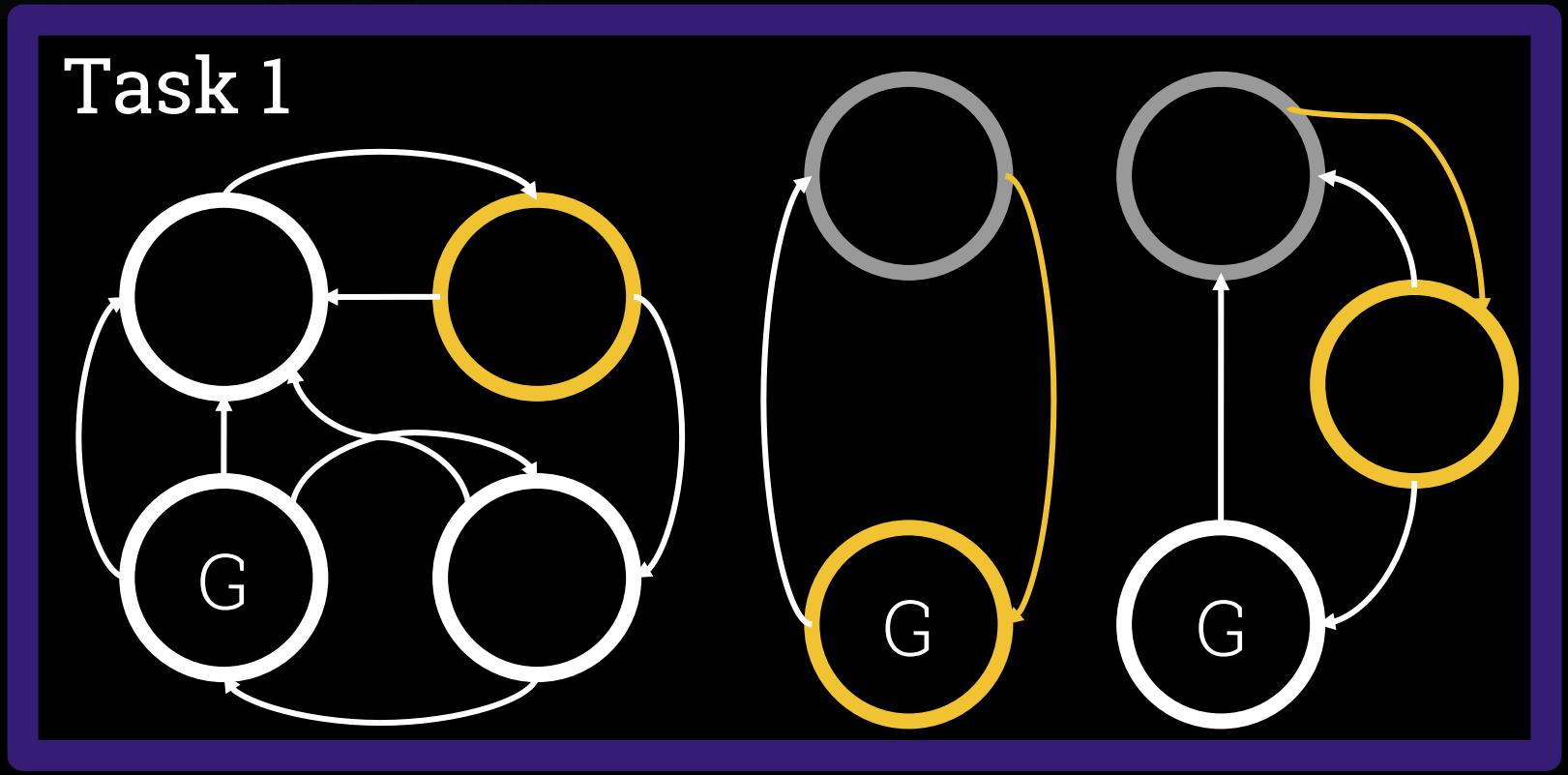

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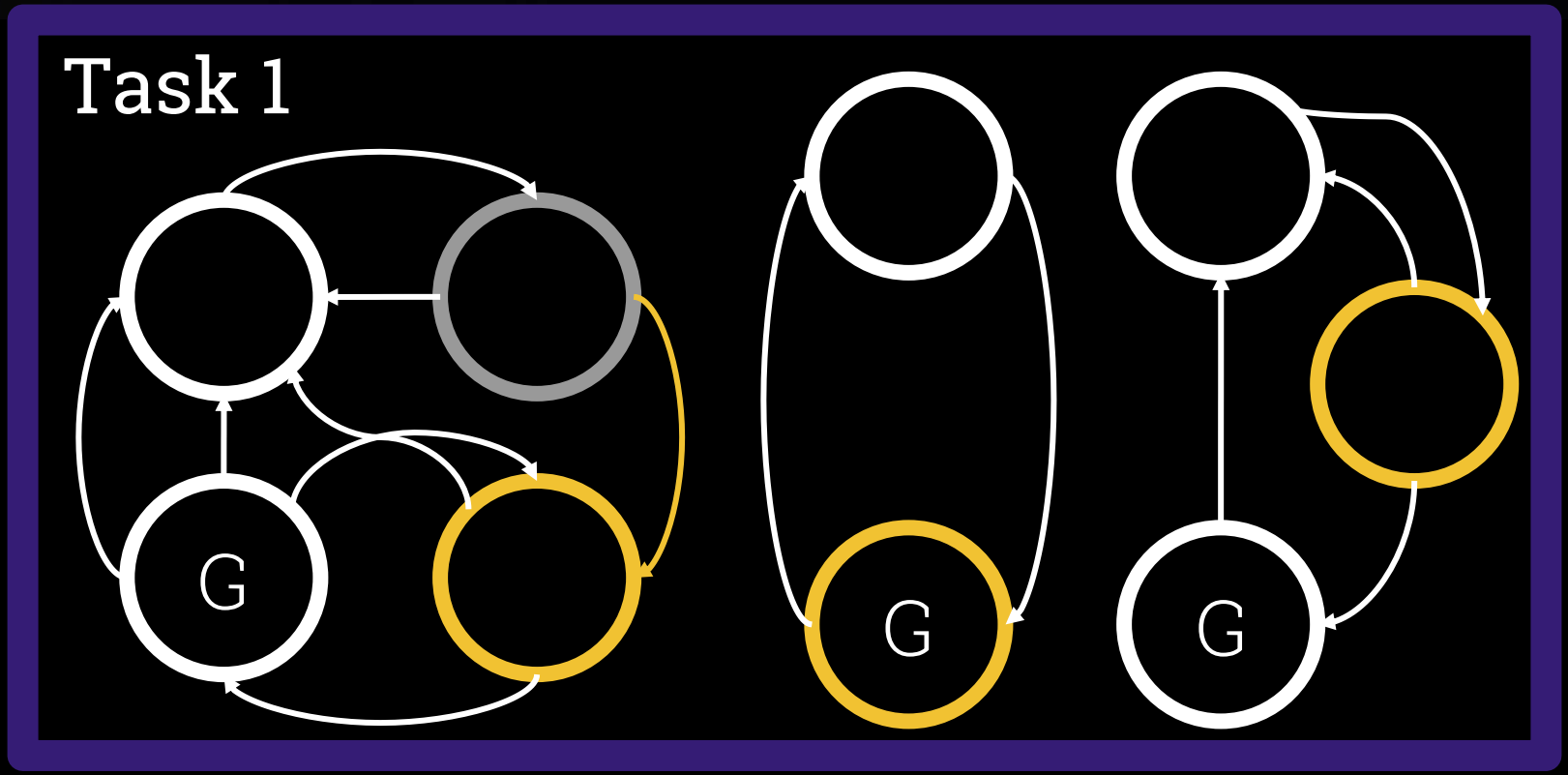

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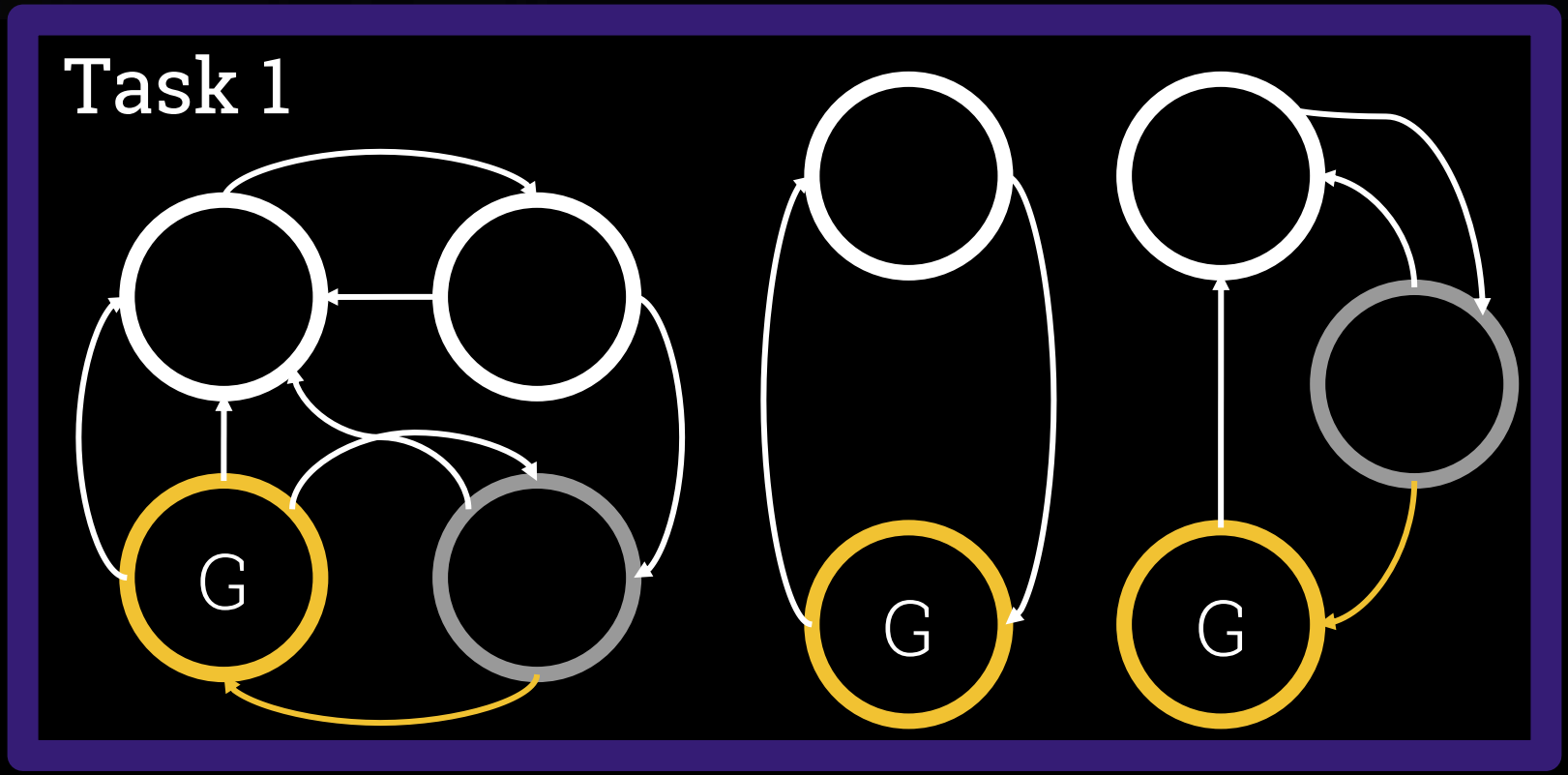

Software

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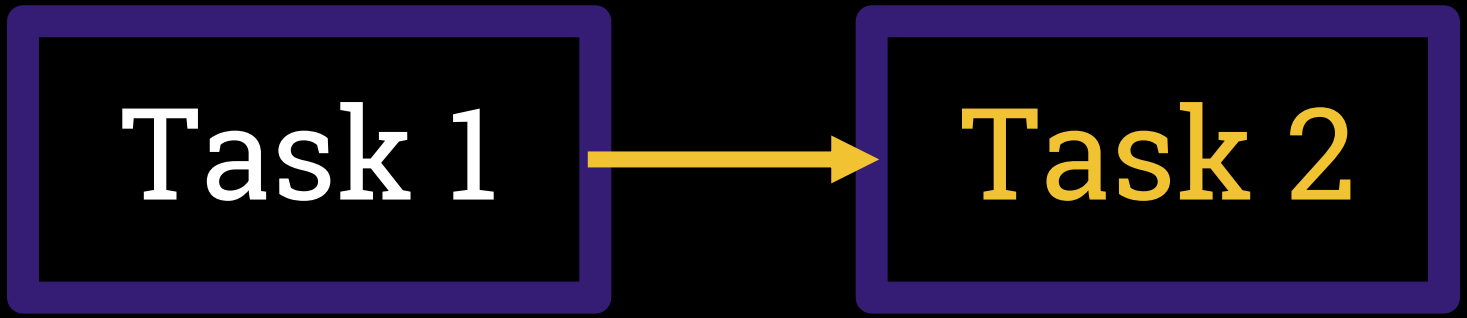
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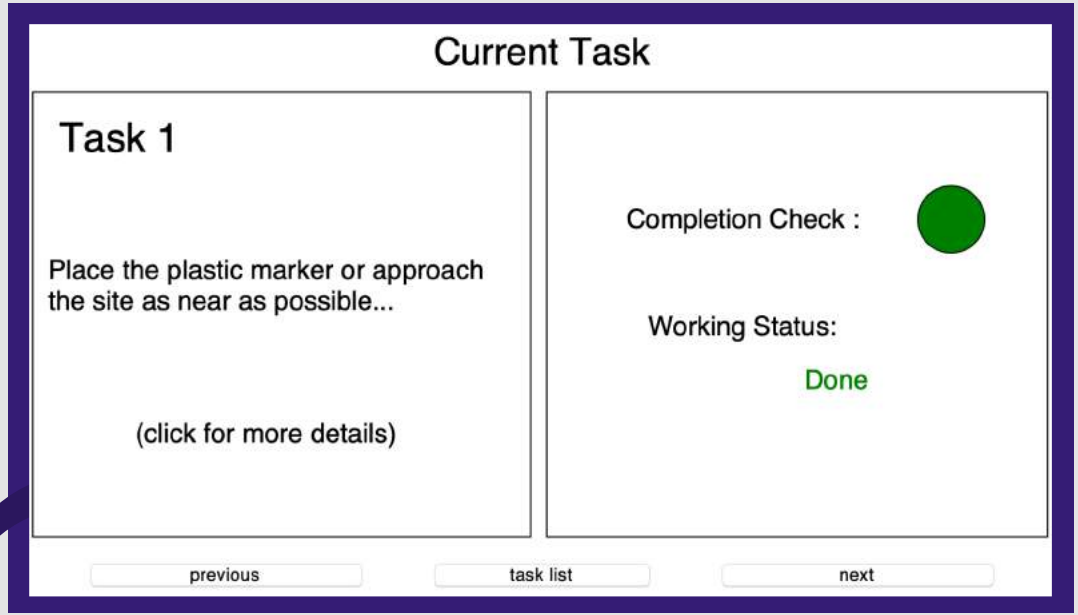


Go to another interface with task details

Green -- “Done”

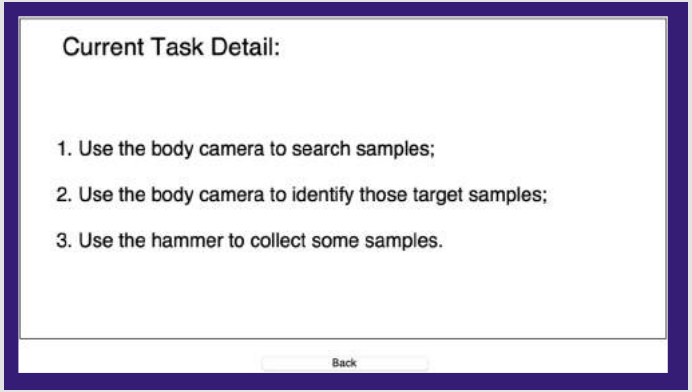
Grey -- “Waiting”

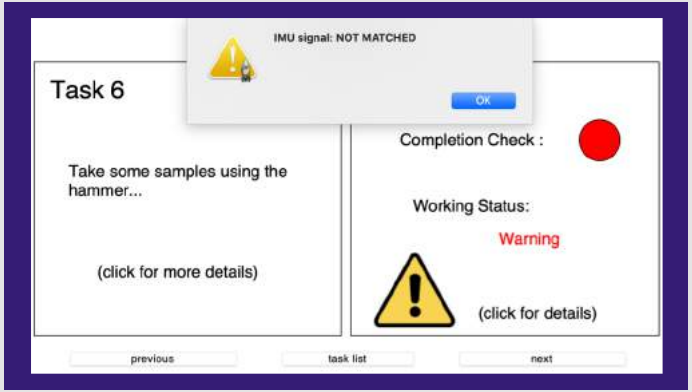
Yellow -- “In-progress”

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.





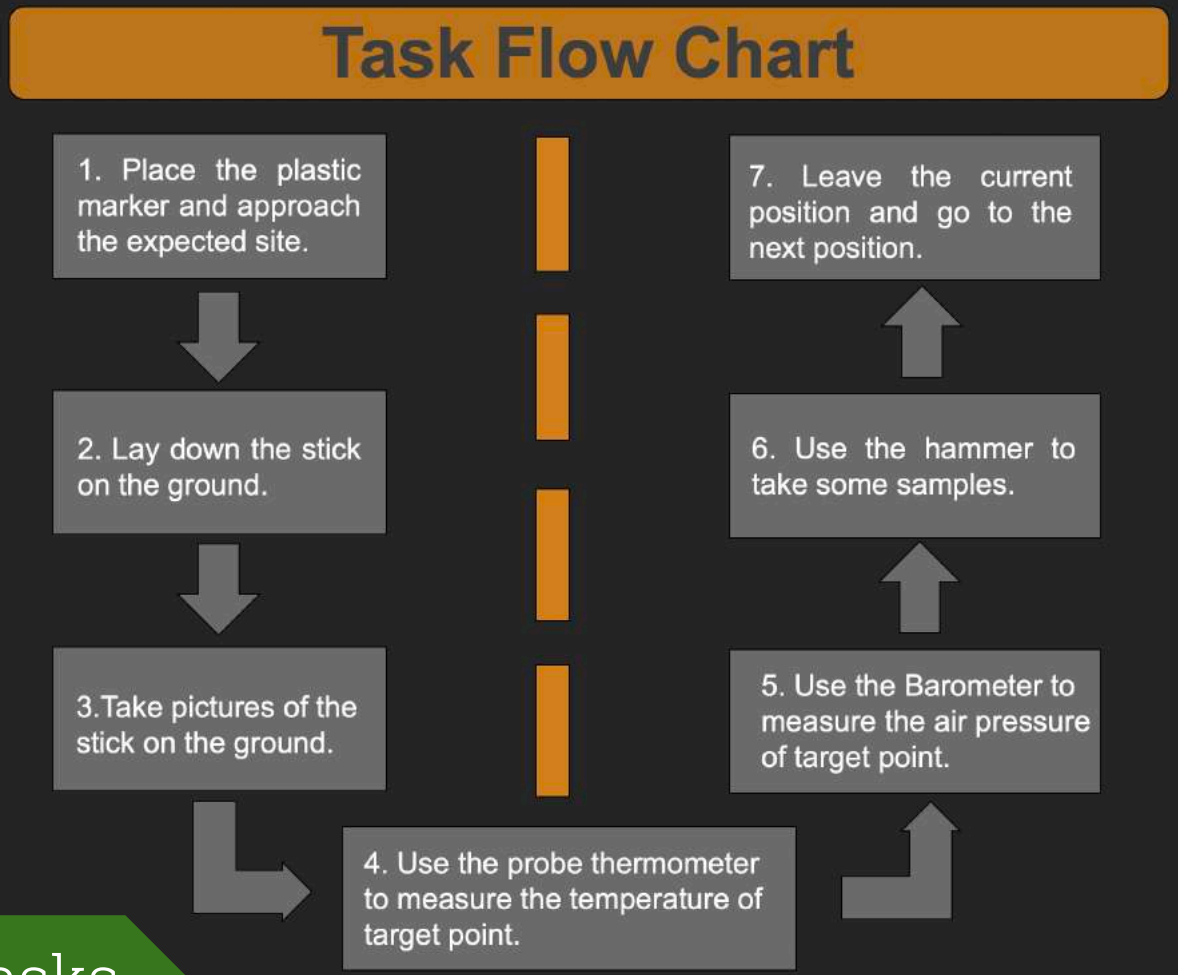
- Task detail interface (upper left)
- Main interface, when working status is warning, indicates user's action is out of accord with that described in task.(upper right)
- The final interface (lower left) allows user to review each task and check the progress.

Watchdog

Demonstration

Video

Watchdog



Sample Tasks

Watchdog

Demo Video

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