Dagu Thumper Fire Fighter

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The initial design of the proposed solution - block diagram

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What are the steps to achieve the final product?

01
Problem Statement

Problem Statement

- Fire outbreaks pose significant threats to life and property.
- With a fire response time of eight minutes, the likelihood of saving a life is approximately 72%. However, if the response time extends to 16 minutes, this probability drops to 45% (Jin & Ahn, 2024).

- Fire outbreaks containment are sometimes slow, putting firefighters and civilians safety at risk.
- According to (Khattri et al., 2024), it was found that there was a linear correlation between the fraction of fires exceeding 30 m^2 and the response time. With each extra minute of response time, approximately 2.3% more fires extended beyond the 30 m^2 threshold.

- According to the National Fire Protection Association (NFPA), during the years 2016 to 2020, over a quarter (26 percent) of the documented fires took place in residential settings. Furthermore, home structure fires accounted for three-quarters (75 percent) of civilian fire fatalities and nearly three-quarters (74 percent) of reported civilian fire injuries during that period (Hall, 2023).

02

Project Description

Our Proposed Solution

- Embedded systems-based firefighting solution for households or small area properties.

- A moving bot that will chase and locate any sensed fire.

- The bot has a water sprinkler system to extinguish the detected fire.

- An alarm system can be installed to notify individuals about the detected fire.

03
Objectives

Objectives & Functionality

- Automatic Fire Detection and Localization.

- Autonomous Navigation

  - Avoid obstacles & plan path.

- Fire Suppression.

- Notification System.

- Low-cost and Fast Firefighting Bot.

04

Hardware Components

Required Hardware Components

Dagu Thumper & Motor Controller

- Chassis with wheels.
- Pololu DMC01 (motor controller).
- Acts as our firefighting bot.

ESP32 MCU Board

- Controls the system and interfaces with the sensors (Flame IR sensors) and actuators (motor, relay, pump, etc.)
- Integrated WiFi modules and Dual-mode Bluetooth.

Required Hardware Components

Flame IR Sensors

- If the sensor is able to perform 360° detection, then we may need only one sensor.

- If 360° detection is not feasible, we plan to initially start with 4 sensors (one at each side) and possibly expand to include front and back corners if needed.

Water System Actuator

- Water tank to store water.
- Water pump.
- Relay controlled by the board that powers the water pump.
- Nozzle for water.
- Micro Servo.

Ultrasonic Sensor HC-SR04

- Detect the existence of surrounding obstacles to avoid them autonomously navigating the dagu thumper
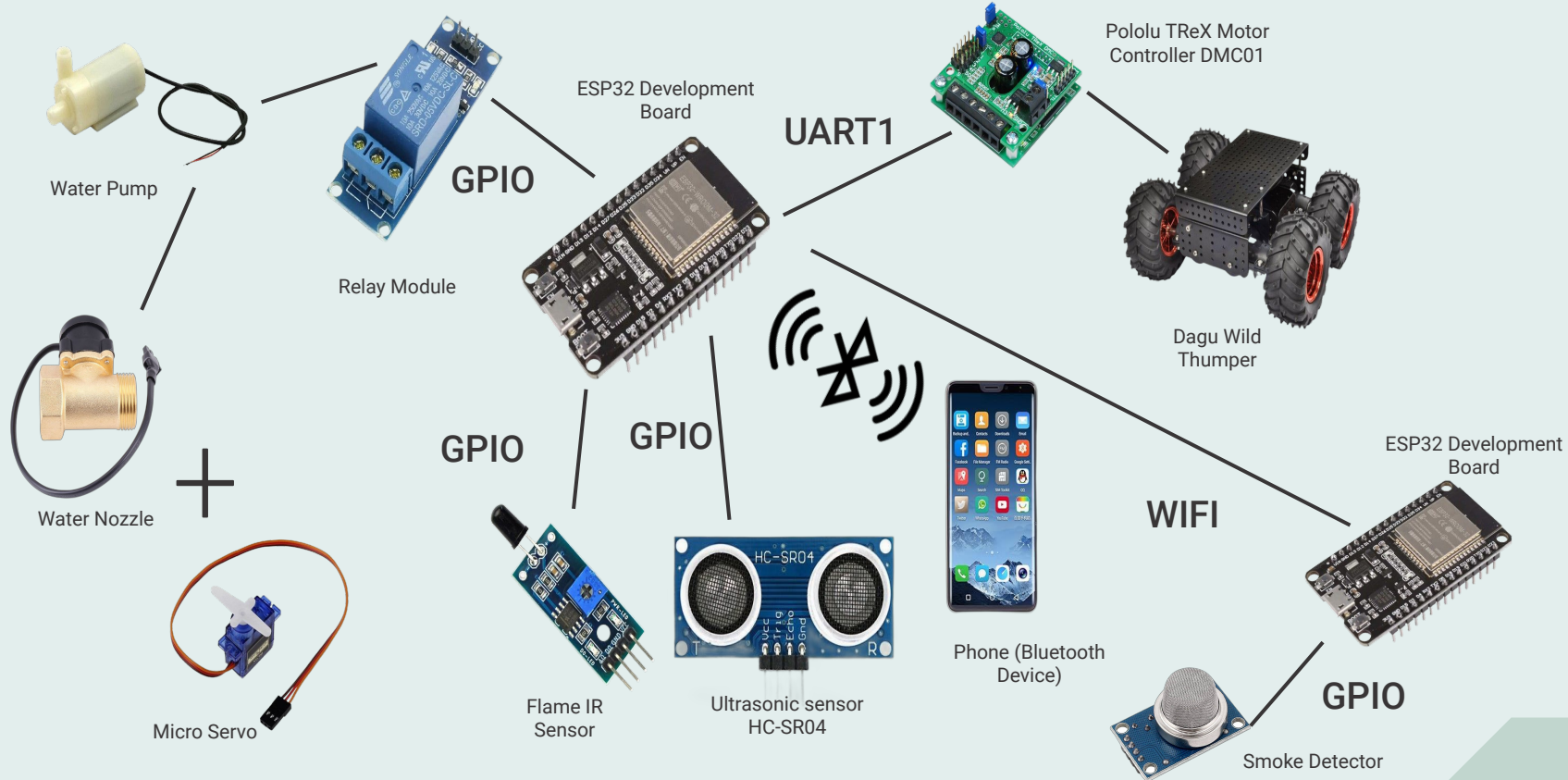
05
Software
Component

Arduino IDE

06

Initial Design

Initial Design

Water Pump

Relay Module

GPIO

ESP32 Development Board

UART1

Pololu TReX Motor Controller DMC01

Dagu Wild Thumper

Water Nozzle

+

Micro Servo

GPIO

GPIO

Flame IR Sensor

Ultrasonic sensor HC-SR04

Phone (Bluetooth Device)

WIFI

ESP32 Development Board

GPIO

Smoke Detector

07

Included Elements

Included Elements

01
Serial Communication (UART) Modules

A UART Module is required for the communication between the TReX motor controller and ESP32 MCU
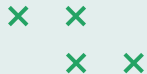
02
GPIO

GPIO pins are required to collect input from sensors and to drive the relay unit

03
Interrupts

Interrupts are triggered based on the data collected by the sensors

08

Plan & Next Steps

Next Steps

Acquire and test All Necessary Hardware Components

01 - By April 18th

02 - By Project Progress Report

Milestone I

- Ensure that all sensors work as expected and Dagu Thumper is able to move towards fire in all directions while avoiding obstacles

Milestone II

- Finish water sprinkling system and integrating it with our bot.
- Send notifications to phone via the bluetooth module

03 - By our In-lab presentation.

04 - By our In-lab presentation.

Finalize & Test Complete System.

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THANKS!

Do you have any questions?