Engineering, Design and Architecture Division
Program of Electrical and Computer Engineering
ANA G. MÉNDEZ UNIVERSITY
UAGM

TrackDUINO
GPS SYSTEM

ELEN 442 Microprocessors I – Final Project

Ariel Arzuaga Rivera | s01307821
Gilberto Ramos Pérez | s01507983

THE PROBLEM

1.



FORGET LOCATION

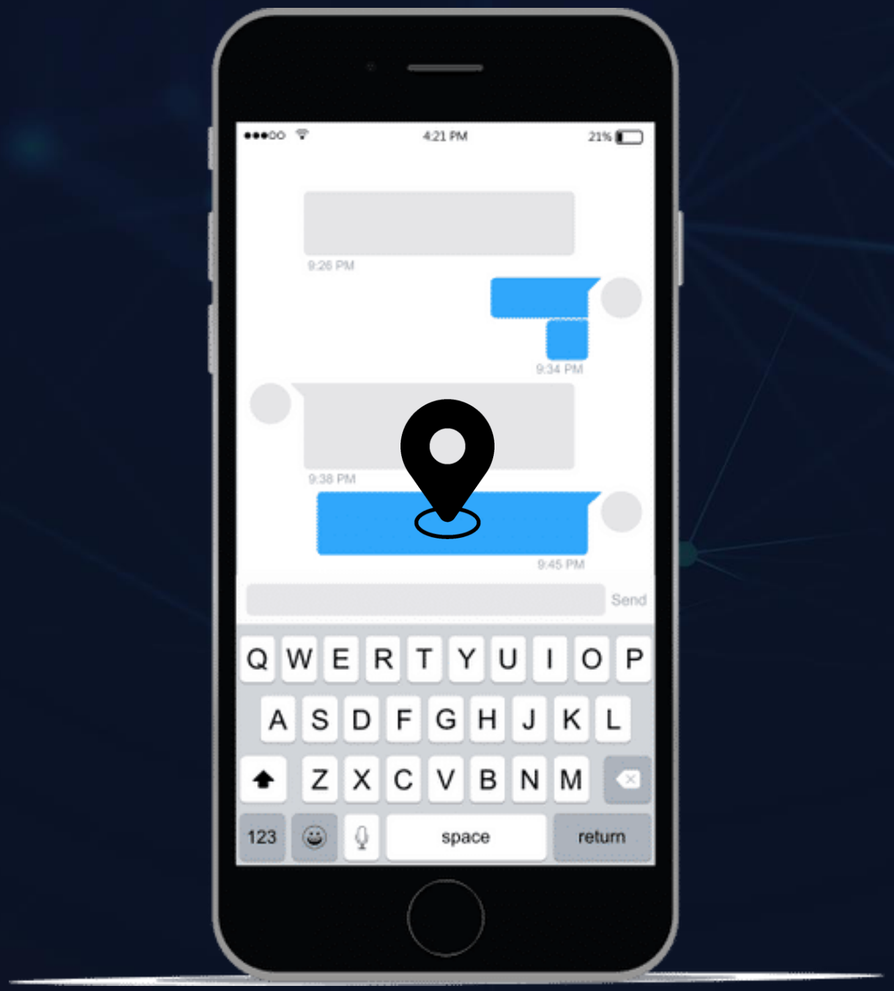
Nowadays, it is common for people to forget the exact location of their vehicles in large, crowded parking lots, causing stress and wasting time.

2.



REQUIRES MANUAL INTERACTION

Although mobile applications and mapping services are available, they often depend on a stable internet connection or continuous manual interaction to be effective with conditions that are not always guaranteed.



SOLUTION AND OBJECTIVES

- The **Trackduino** project provides a practical and affordable alternative to this problem by leveraging the power of Arduino microcontrollers and GPS modules. This allows autonomous vehicle localization **without the need for internet access.**
- **The user sends an SMS requesting the location of the vehicle.**
- Its design is aimed at being simple to implement and operate, making it ideal for users with varying levels of technical expertise.
- This document outlines the objectives, methodology, and costs associated with the project, as well as its practical implications.

COMPONENT SELECTION AND CONSIDERATIONS: NEEDS TO BE...

B. GPS Module (SIM7000G NB-IOT HAT)

This module is a multiband LTE module and dual-band GPRS/EDGE device designed to operate with a SIM card, enabling the Trackduino to function independently of a GSM connection. Originally created as a HAT for seamless integration with a Raspberry Pi single-board computer, this module can also be adapted for use with an Arduino Nano using UART ports.



Fig. 2. SIM7000G NB-IOT HAT with GPS Antenna

Power supply	5V
Operating voltage	5V/3.3V (3.3V by default)
Operating Voltage	Sleep Mode: 1.2mA(@DRX=2.56s)
Power Save Mode current:	9 μA
Protocols Supported	TCP, UDP, PPP, HTTP, FTP, MQTT, SMS, Mail, etc.
Navigation Systems	GPS, GNSS, GLONASS,BeiDou, and Galileo
SIM Card Compatibility	Normal SIM card and NB-IoT specific card
Baudrate	300bps~3686400bps
Control Langauge	AT commands (3GPP TS 27.007, 27.005, and SIMCOM enhanced AT Commands)
Data Speed	Uplink ≤ 66 kbps / Downlink ≤ 34 kbps
PCB Size	30.2mm x 65mm
Weight	0.132 kg.

[b] SIM7000G NB-IOT HAT General Specifications

A. Arduino NANO.

This will serve as the main controller for managing Trackduino's operations. Its small footprint will aid in the compact aspect of the design.



Fig. 1. Arduino NANO Microcontroller

Microcontroller	ATmega328
Architecture	AVR
Operating Voltage	5 V
Flash Memory	32 KB of which 2 KB used by bootloader
SRAM	2 KB
Clock Speed	16 MHz
Analog Input Pins	8
EEPROM	1 KB
DC Current per I/O Pins	20 mA (I/O Pins)
Input Voltage	7-12V
Digital I/O Pins	22 (6 of which are PWM)
PWM Output	6
Power Consumption	19 mA
PCB Size	18 x 45 mm
Weight	7 g

[a] Arduino NANO General Specifications

Independent Device



Low-cost



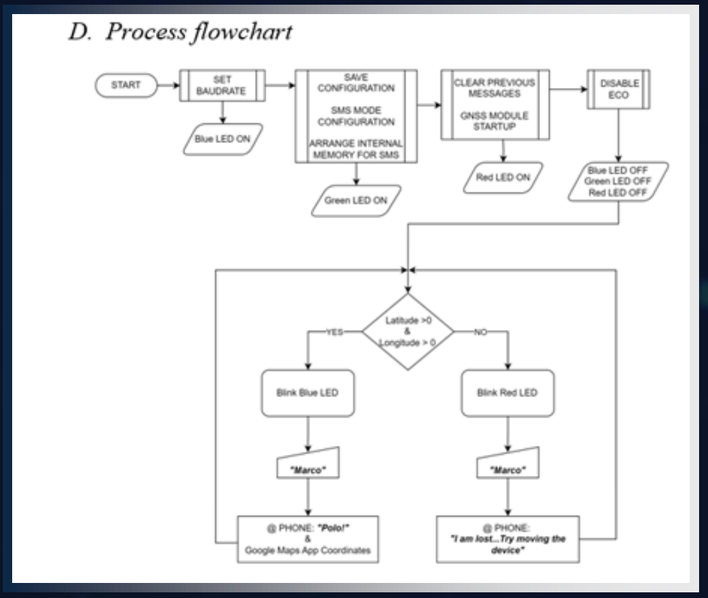
User-friendly



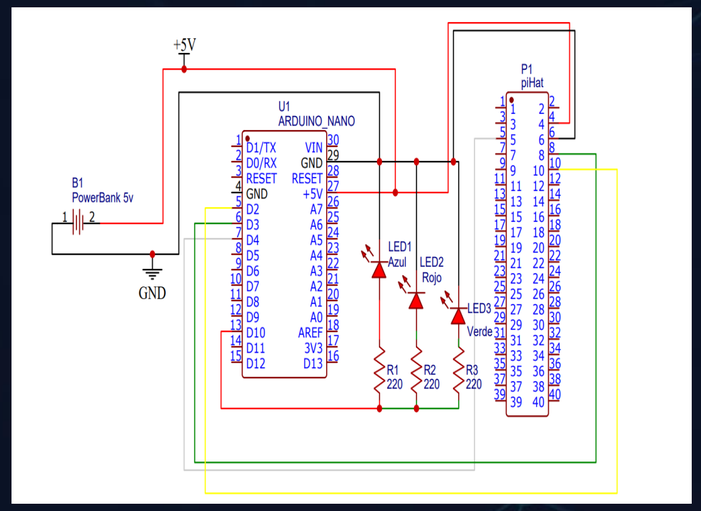
Plug-and-play



EACH COMPONENT WAS CAREFULLY SELECTED WITH THESE CONSIDERATIONS IN MIND.







1) Blue

When running set-up

a) Debugging process being carried out

b) Baudrate is set

c) Saving configuration

d) SMS mode text is enabled

When running loop

e) GNSS location established (blinking)

2) Green

When running set-up

a) Empty previous messages from memory

b) GNSS module startup

c) ECO commands disabled

When running loop

d) SMS Recieved

3) Red

When running set-up

a) Clear previous messages

b) GnSS module startup

When running loop

c) GNSS location not established (Blinking)

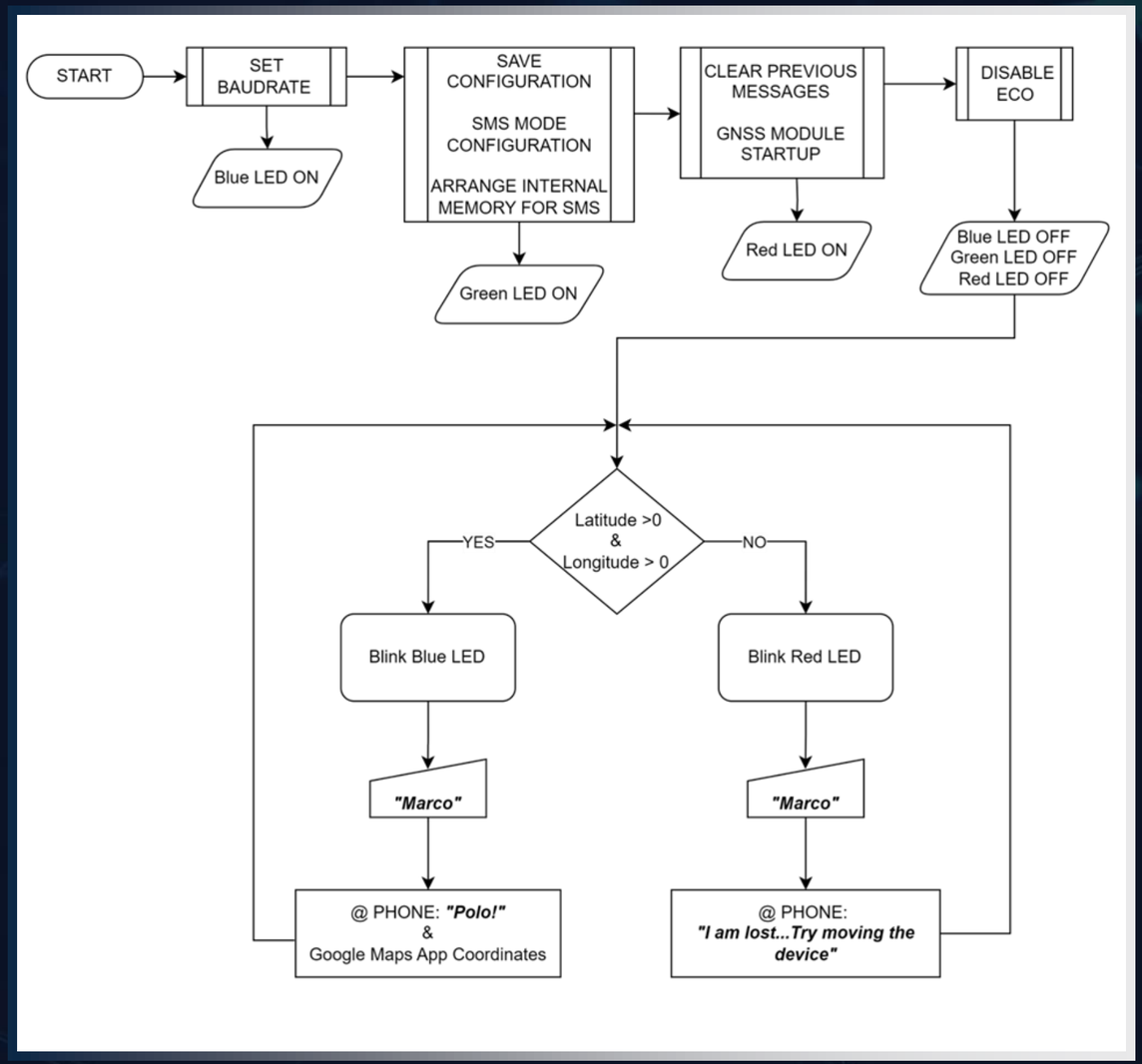
DESIGN

- To provide feedback of the system's progress and to keep the GPS device compact and affordable, a simple three-LED method was chosen over an LCD.
- The **blue**, **green**, and **red** LEDs light up sequentially, serving as a progress bar.

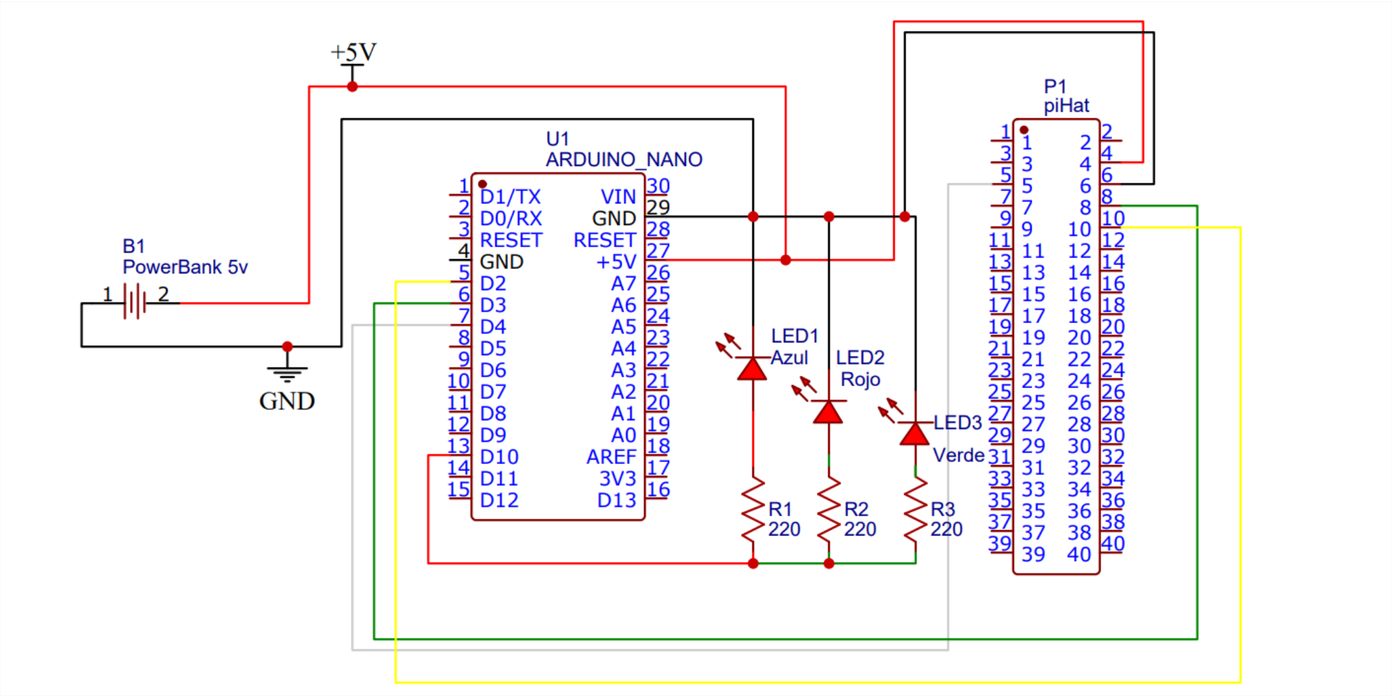
Nevertheless, each color focuses on signaling specific important processes:

- With the target phone number stored in memory, the user can command the Trackduino to provide its precise location.
- Texting the word **"Marco"** will trigger the response **"Polo"** followed by the exact latitude, longitude, and altitude in a format optimized for use with the Google Maps app

FLOWCHART


START
SET BAUDRATE
Blue LED ON
SAVE CONFIGURATION
SMS MODE CONFIGURATION
ARRANGE INTERNAL MEMORY FOR SMS
Green LED ON
CLEAR PREVIOUS MESSAGES
GNSS MODULE STARTUP
Red LED ON
DISABLE ECO
Blue LED OFF
Green LED OFF
Red LED OFF
Latitude >0
&
Longitude > 0
YES
NO
Blink Blue LED
"Marco"
@ PHONE: "Polo!"
&
Google Maps App Coordinates
Blink Red LED
"Marco"
@ PHONE:
"I am lost...Try moving the device"

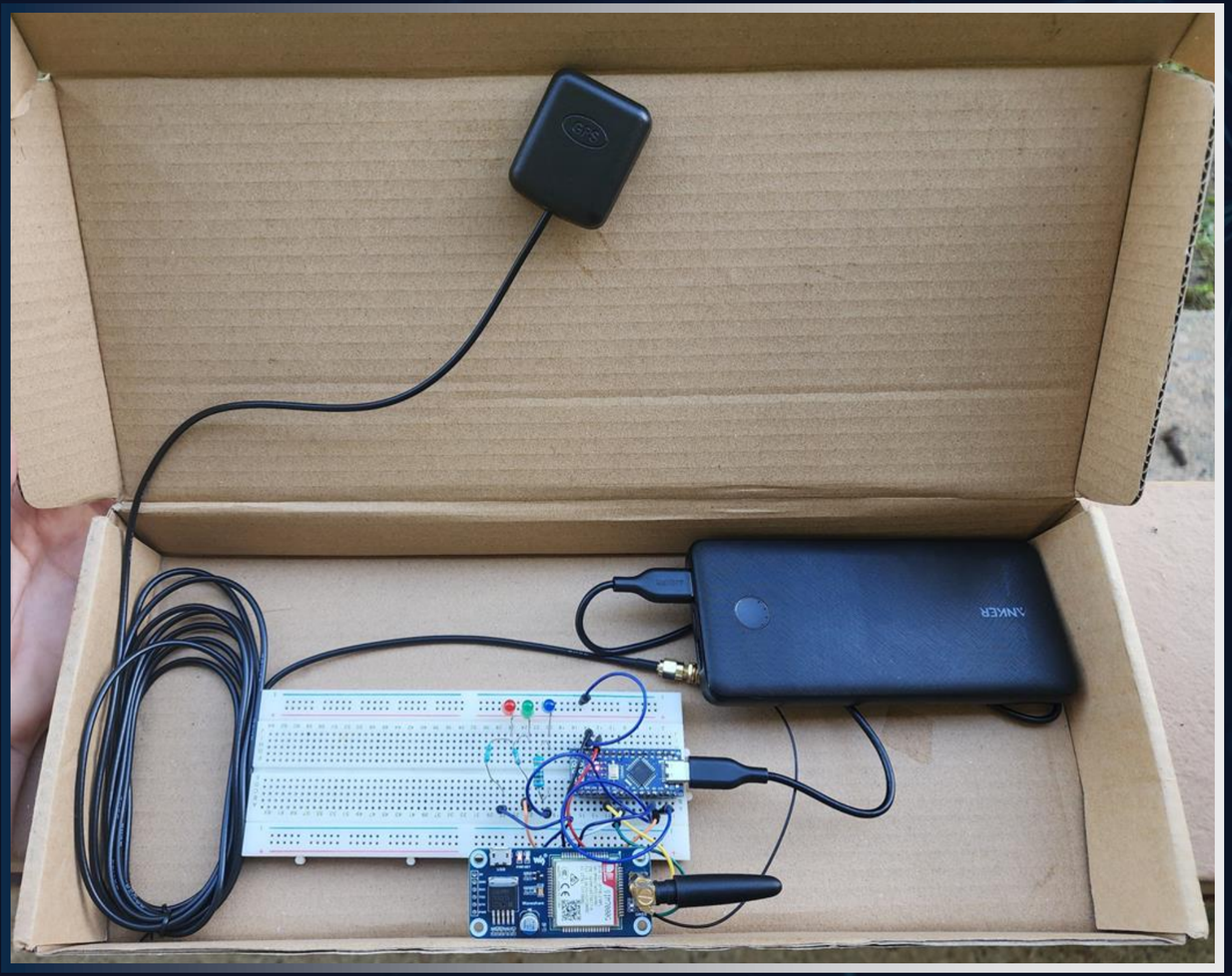
SCHEMATICS



SIM7000G GPIO pin	SIM7000G VALUE	Color	Arduino
4	5v	RED	5V
6	GND	**BLACK**	GND
10	TX	YELLOW	D2 (RX)
8	RX	GREEN	D3 (TX)
7	ON/OFF	WHITE	D4

SIM7000G TO ARDUINO PIN CONNECTION TABLE

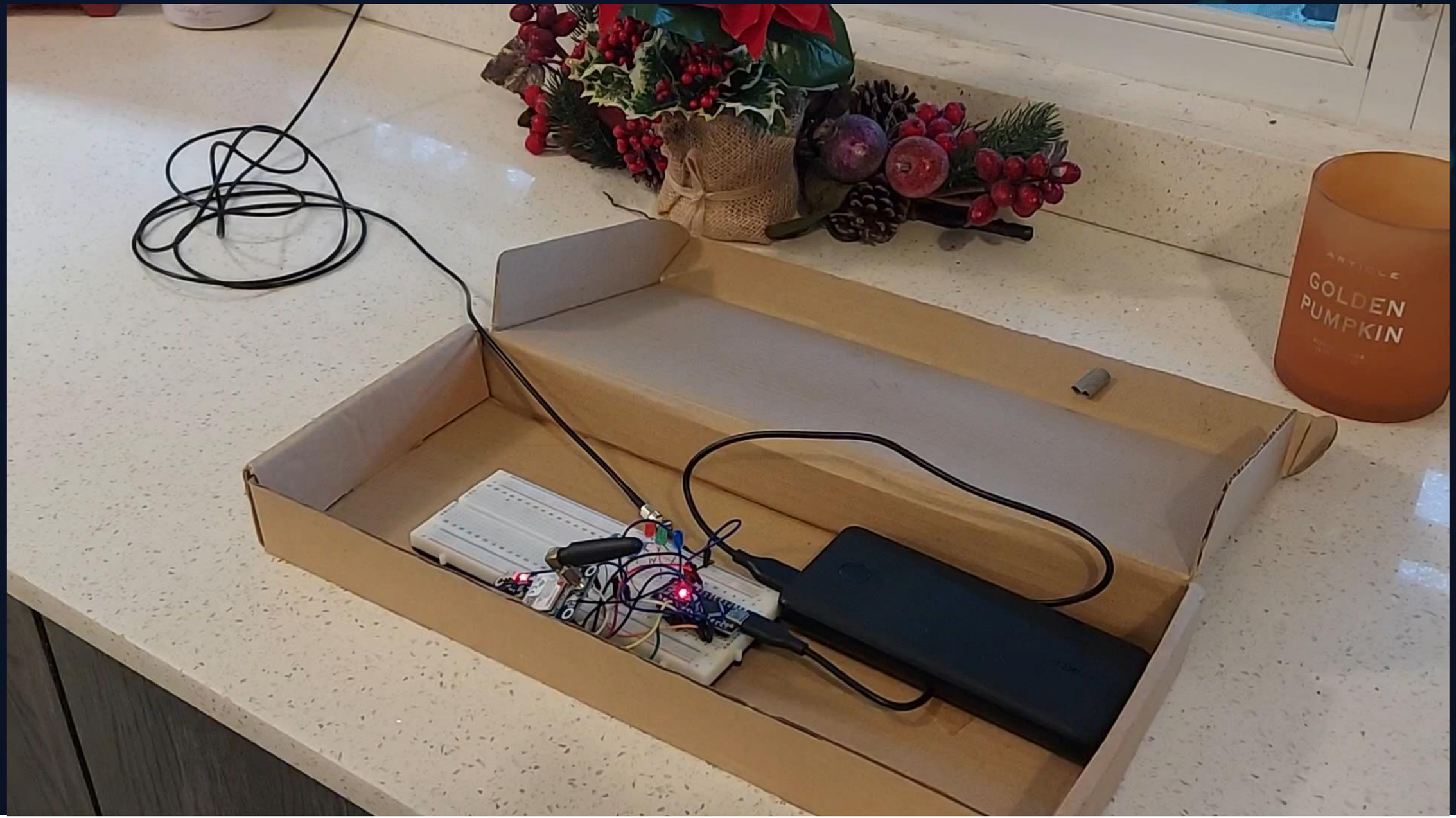
PROTOTYPE



COSTS

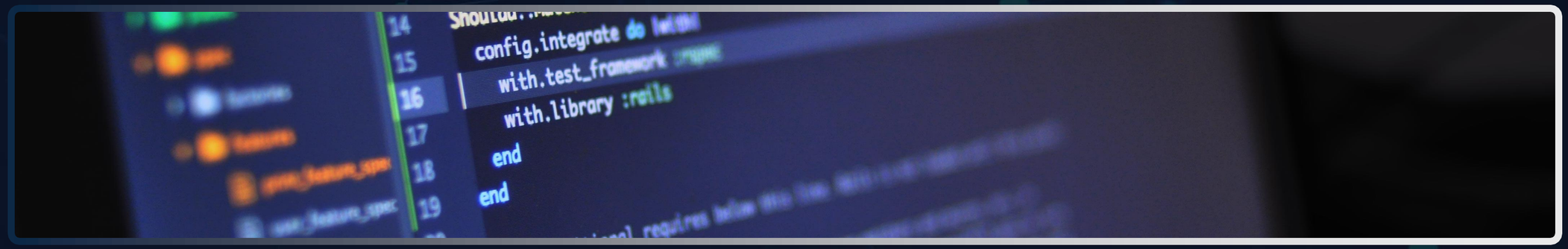
VENDOR	*DESCRIPTION*	*COST*
Arduino	Arduino Nano	$21.17
Waveshare	SIM7000G NB-IoT HAT GPS Module	$36.99
Amazon	Breadboard Kit	$9.99

TOTAL: $68.15


GOLDEN
PUMPKIN

CODE IN GITHUB REPOSITORY

https://github.com/Arz18/ArduTracker/blob/main/ARDUTRACKER_FUNCIONAL.ino



REFERENCES

ALL BACKGROUND IMAGES USED ARE LICENSE FREE FROM HTTPS://WWW.ISTOCKPHOTO.COM/ and CANVA.com

[1] J. Zheng, "Design and Implementation of a Car-Location System Using GPS and GSM," International Journal of Engineering Research & Technology (IJERT), vol. 9, no. 6, pp. 1–5, Jun. 2020.

[2] T. R. Singh, M. Kumar, and R. S. Verma, "Real-Time Vehicle Tracking System Using Arduino and GSM Module," International Journal of Engineering and Advanced Technology (IJEAT), vol. 8, no. 6, pp. 3406–3410, Nov. 2019.

[3] Adafruit Learning System, "Using GPS with Arduino,". https://learn.adafruit.com/adafruit-ultimate-gps.

[4] A. Chowdhury, S. Roy, and D. Gupta, "IoT-Based Parking Assistance System Using GPS and RFID," Internet of Things and Cloud Computing, vol. 10, no. 2, pp. 65–71, Apr. 2022.

[5] Waveshare, SIM7000E NB-IoT HAT for Raspberry Pi User Manual, Waveshare, 2024. https://www.waveshare.com/sim7000e-nb-iot-hat.htm..

[6] On The Map Marketing. (n.d.). Google Maps statistics: Verified and updated for 2024. https://www.onthemap.com/blog/google-maps-statistics/

QUESTIONS?

