EC6020

Embedded Systems Design

Project Proposal

SmartTrack: IoT vehicle monitoring and control system for Rent-a-Car service owners

26th January 2025

BY,

GROUP 28

CHANDRASIRI P.G.P.M.	**2021/E/108**
KULATHUNGA K.M.P.S.	**2021/E/078**
BANDARA H.M.S.A.	**2021/E/187**
DHARMADASA H.M.D.S.	**2021/E/046**

TITLE:

SmartTrack: IoT Vehicle Monitoring and Control System for Rent-a-Car Service Owners

INTRODUCTION:

Managing rental vehicles involves challenges such as vehicle misuse, theft, and lack of real-time insights into vehicle status. **SmartTrack** offers a comprehensive IoT-based solution tailored for rent-a-car service owners. This system includes a mobile app (for owners and drivers), a discreet ESP32 module, and a cloud-based monitoring platform. The system provides real-time location tracking, fire and temperature alerts, and driver-specific functionalities, ensuring both safety and accountability for vehicle operations.

NOVELTY:

This system uniquely addresses both vehicle owners' and drivers' needs through a unified IoT solution leveraging ESP32 modules and a mobile app. By integrating speed monitoring, fire detection, live tracking, and driver-specific features like buzzer control, SmartTrack delivers an unparalleled combination of safety, control, and theft prevention.

DESIGN OVERVIEW:

System Architecture: A centralized ESP32 microcontroller integrates the system's components.

- A A9G module tracks the Vehicle's location.
- A mobile app receives alerts, displays real-time locations.
- A buzzer provides audio alerts, which can be controlled via the mobile app.
- DHT11 takes environmental information check whether is there any fire or emergency.

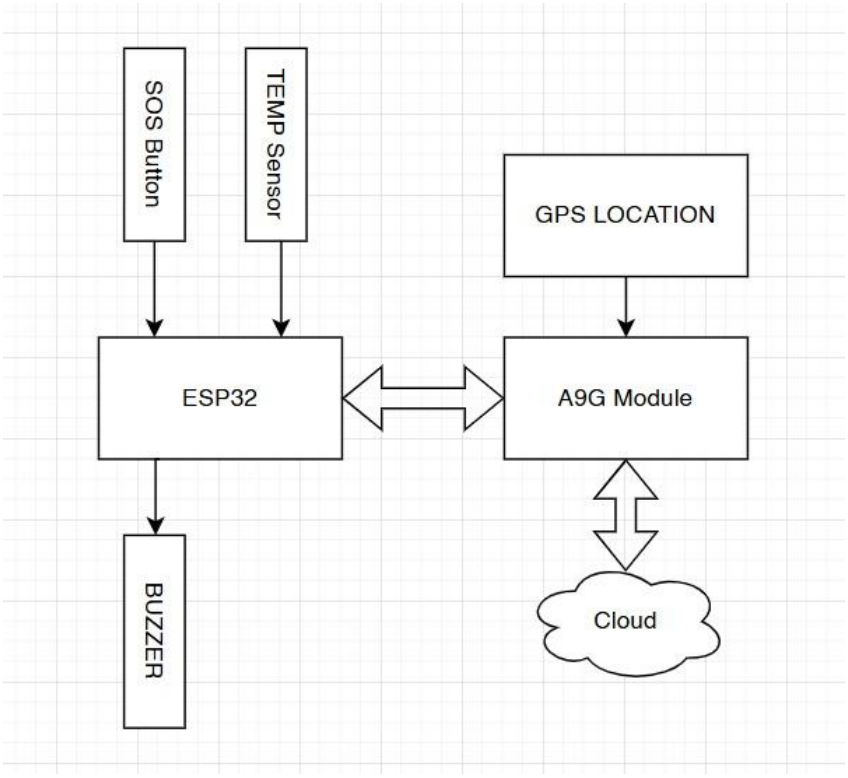

Figure 1: Block diagram.

Protocols:

- **UART** - For communication between the GPS module and the ESP32.
- **GPIO** - To control the buzzer.
- **RX-TX** - For serial data transmission between the ESP32 and connected modules.
- **Arduino cloud service** - For real-time data monitoring, alert notifications, and remote system management.

Circuit Design:

- A9G module connected to the ESP32 via UART.
- Cellular Network connected to the ESP32 via MQTT.
- Buzzer and LEDs connected to ESP32 GPIO pins for alert signals.
- Mobile app communication enabled via Cellular Network.

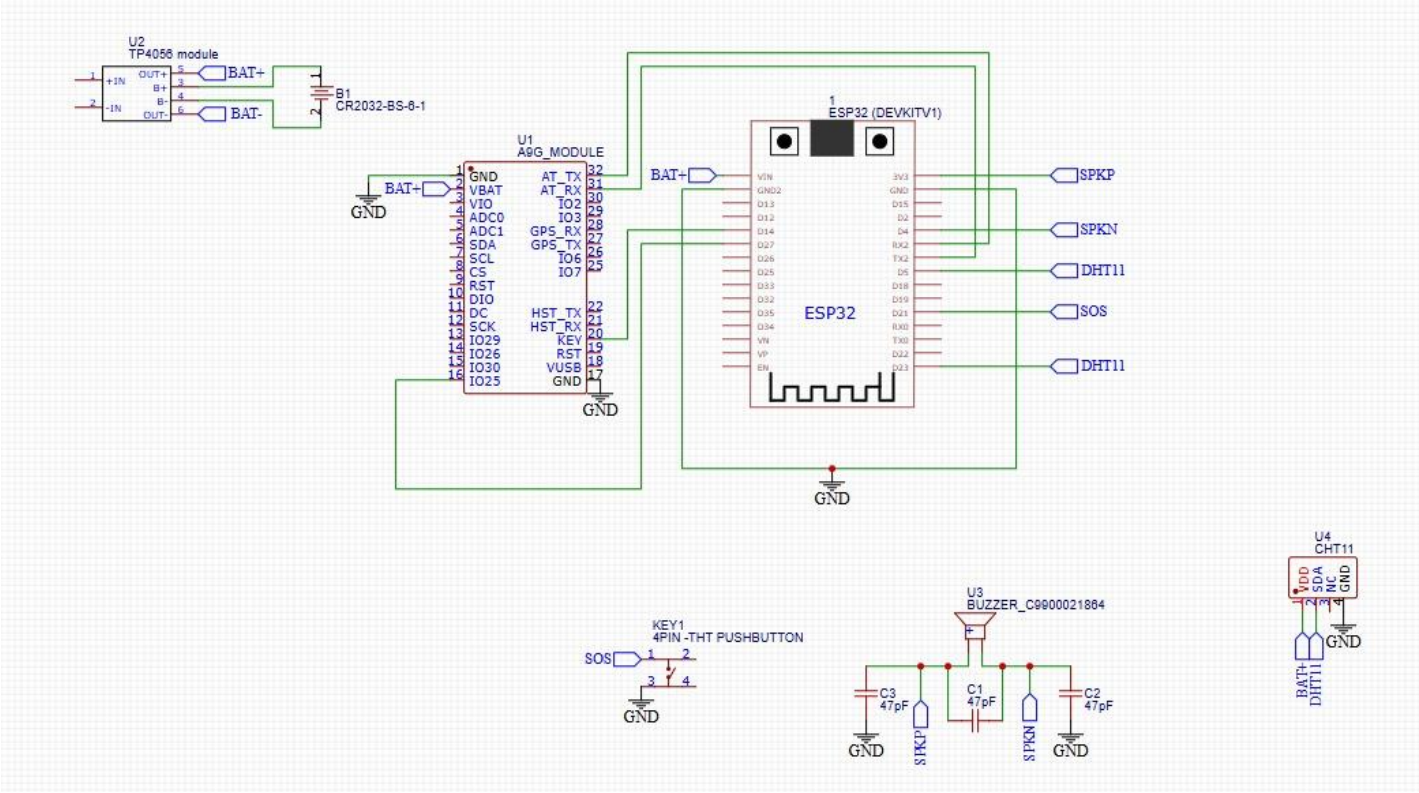

Figure 2: Circuit diagram.

TECHNOLOGIES TO BE USED:

List of Hardware Components:

1. **ESP32 microcontroller** - For GPS tracking, vehicle access control, and app communication.
2. **DHT 11 - To monitor real** - time vehicle cabin or engine temperature.
3. **Push button** - For manual triggering of the buzzer or other emergency actions.
4. **A9G GPS GSM GPRS development module** - For real-time location tracking and communication via GSM.
5. **TP4056 (Charging module)** - To ensure the ESP32 module has a stable power supply from a backup battery.
6. **Buzzer (12V)** - For parking assistance or locating the vehicle in crowded areas.

Software Technologies:

1. **Programming Languages** - C/C++ for ESP32, React Native for mobile app development, React for portfolio website.
2. Communication MQTT protocol for efficient data exchange between the app and ESP32.
3. Arduino IoT Cloud library in ESP32, code to simplify cloud integration and data uploads.

UNIQUENESS:

1. **Explanation of What Makes the Project Innovative.**
   - **Dedicated dual-panel system -** Unlike many generic vehicle trackers, this system provides a specific interface for both vehicle owners and drivers.
   - **Customizable safety alerts -** Owners can pre-define speed limits and receive instant alerts for violations.
   - **Fire and temperature sensors -** These integrated sensors ensure real-time vehicle safety monitoring.
   - **Stealthy tracker placement -** Reduces the chances of thieves finding and disabling the module.
   - **Driver-controlled buzzer -** A practical feature for locating parked vehicles efficiently.
2. **Comparisons with Existing Solutions.**
   - **Generic GPS Trackers -** Most GPS trackers only offer location tracking without additional sensors or app integration.
   - **Fleet Management Systems -** While fleet systems provide some advanced features, they are typically expensive and not designed for small-scale rent-a-car services.
   - **SmartTrack -** Affordable, compact, and designed specifically for small to medium-scale rental businesses with a focus on real-time safety and monitoring.

BUDGET:

Component	Quantity	Unit Cost (LKR)	Total Cost (LKR)
ESP32 microcontroller	1	1950	1950
DHT 11	1	390	390
Push button	1	50	50
A9G GPS GSM GPRS development module	1	4650	4650
TP4056 (Charging module)	1	120	120
Buzzer (12V)	1	80	80
Other components (Capacitors, Resistors, Wires)	1	400	400
PCB	1	500	500
Total Estimated Cost			**8140**

TIMELINE:

Task	Week							
	4	**5**	**6**	**8**	**9**	**12**	**13**	**14**
Requirement gathering, hardware selection.								
Working hardware prototype.								
PCB creation.								
Coding part of ESP32 board.								
Mobile app frontend.								
Mobile app backend.								
Portfolio website creation.								
Final report submission and presentation.								

GITHUB REPOSITORY:

Link - https://github.com/PramudaKulathunga/SmartTrack