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A New Compact GPS-based Tracking and Navigation System

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ABSTRACT: This paper presents the design and implementation of a compact GPS-based navigation system using an Arduino Nano. The system is equipped with a NEO-7M GPS module to obtain real-time location coordinates, an OLED display to show location data, a SIM800L GPRS module to communicate with a remote server, and a buzzer for alert signals. The LM2596 buck converter is used to ensure power supply regulation.

Keywords: Electronic GPS navigation, GPS based tracking, vehicle tracking, GPS timing

I. INTRODUCTION

Navigation and location tracking systems have become integral to modern applications ranging from personal safety to intelligent transportation. The evolution of the Global Positioning System (GPS) has made it possible to pinpoint location with great accuracy [1,2] and speed. This project leverages GPS technology using the NEO-7M module and integrates it with the Arduino Nano microcontroller to design a real-time, low-power, and cost-effective navigation [3,4] system.

With growing demand for real-time tracking in personal, commercial, and security domains, the role of compact embedded systems is increasingly important. Arduino-based solutions are especially attractive due to their open-source nature, ease of programming, and extensive community support.

In this paper, we have developed a new GPS navigation system that uses GPS data to determine current location and displays it on an OLED screen. It iincludes a GPRS-based [5-7] communication module (SIM800L) to send this data to a server or mobile number and a buzzer for alert notifications. A buck convetter (LM2596) ensures the entire circuit receives a steady, efficient power supply.

Section I. Operational mechanism

The GPS module receives signals from satellites and calculates the device's current location (latitude, longitude). The Arduino Nano reads this data and displays it on the OLED screen.

Simultaneously, the SIM800L module is used to send the location data via SMS or over GPRS. The buzzer is triggered to alert users in specific scenarios (e.g., entering a defined geo-fence or losing signal). Power is supplied to the whole system through a 12V source regulated to 5V/3.7V using an LM2596 buck converter.

Section II. Hardware block diagram

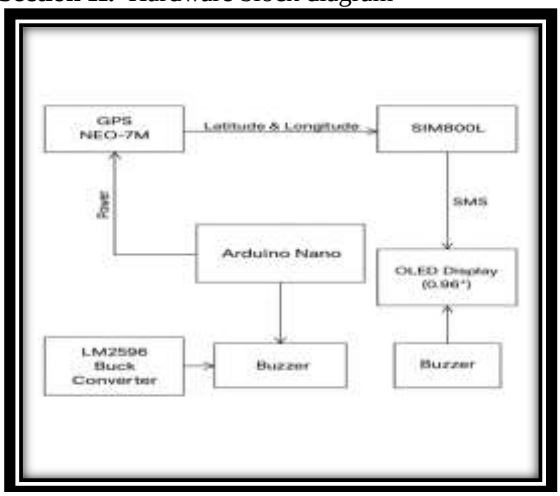

Fig 1. Block diagram of the GPS navigation system.

The system comprises of the following main modules:

- Arduino Nano (central controller)
- NEO-7M GPS Module (for location)
- OLED Display (for visual output)
- SIM800L GPRS Module (for remote communication)

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- Buzzer (for audio alerts)
- LM2596 Buck Converter (for power regulation)

Section III. Circuit diagram

The circuit diagram for the navigation system is shown below.

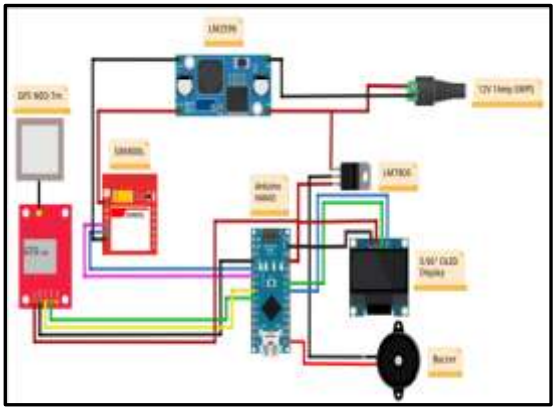

Fig 2. Circuit diagram for the GPS navigation system.

The circuit consists of:

- Arduino Nano at the center
- GPS module connected via serial pins
- OLED display via I2C
- SIM800L through software serial
- Buzzer on digital output pin
- LM2596 Buck Converter between power supply and modules

Section IV. Operational software flowchart

The operational flowchart for the navigation system is illustrated in Fig 2.

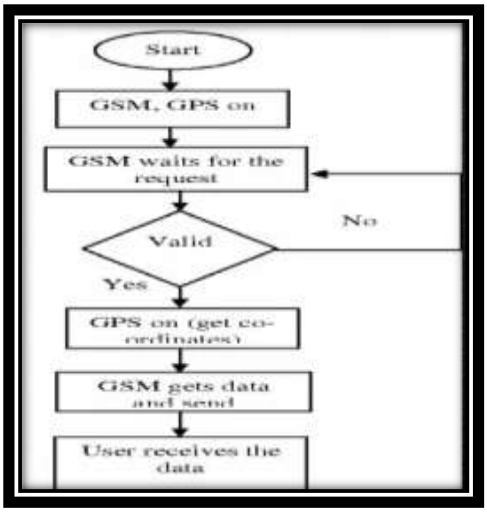

Fig 3. Operational flowchart for the GPS navigation system.

Component steps for operation are the following:

1. Initialize modules.
2. Acquire GPS data.
3. Display on OLED.
4. Send data via SIM800L.
5. Trigger buzzer on event.
6. Repeat.

Section V. Software implementation

Software tools used

- **Arduino IDE:** Version 1.8+ (for code writing and uploading)
- **SoftwareSerial Library:** For SIM800L serial communication
- **Adafruit_SSD1306 and GFX Libraries:** For OLED display interface
- **TinyGPS++ Library:** For parsing GPS data

These libraries are open-source and available via Arduino Library Manager

Section VI. Discussion and inference

Execution Steps

1. **Initialize all hardware** via setup().
2. **Continuously read GPS data** from the NEO-7M.
3. **Check if new coordinates are available.**
4. **Display coordinates on OLED.**
5. **Send SMS with location via SIM800L.**
6. **Trigger buzzer to alert event (optional).**
7. **Repeat every 5–10 seconds.**

II. CONCLUSION

The GPS-based navigation and tracking system developed in this paper demonstrates a cost-effective and reliable solution for real-time location monitoring using easily available electronic components. Powered by the Arduino Nano microcontroller and integrated with the GPS NEO-7M module, OLED display, and SIM800L GSM/GPRS module, the system successfully retrieves and displays current location coordinates and transmits them via SMS to a designated recipient

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