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Smart Vehicular Traffic Management System using RFID Technology

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Introduction

Public places are often characterized with incessant traffic congestion, especially during special occasions and events, as large number of automobiles attempt to use the same parking lot concurrently.

This usually result in confusion and dispute, auto crashes, waste of time and resources, and release of more carbon into the ecosystem.

Introduction (*Cont'd*)

- RFID is a convenient and flexible technology well suited for fully automated systems [1].
- Data can be stored on and read from RFID tags embedded or attached to objects, and it can be wirelessly transmitted to RFID readers via reader antenna [6, 7].

Introduction (*Cont'd*)

- Unlike automatic license plate recognition (ALPR) technology [12], the operation of automobile recognition system using RFID technology is more efficient as it does not require complex processes of segmentation.

Introduction (*Cont'd*)

- Although several work have been done on vehicle identification and localization using RFID technology [13-20], large-scale implementation of RFID-based vehicular access control in a smart-green city requires a stable power supply that poses no threat to our ecosystem.
- Unfortunately, the power grid in most developing countries today are majorly fossil-fuel dependent and highly unreliable.

Research Aim

- This work aimed at integrating Solar Photovoltaic (SPV) technology into RFID-based automobile recognition system for efficient, eco-friendly, intelligent parking solution for smart and connected communities in developing countries.

System Design

- The smart traffic management system was designed for Canaanland city, Ota, Nigeria using RFID and LoRaWAN technologies as shown in Figure 1.
- Parking lots are allocated to vehicles based on availability.
- At the city main entrance, pre-programmed RFID tags are assigned to each of these vehicles.

System Design Method (*Cont'd*)

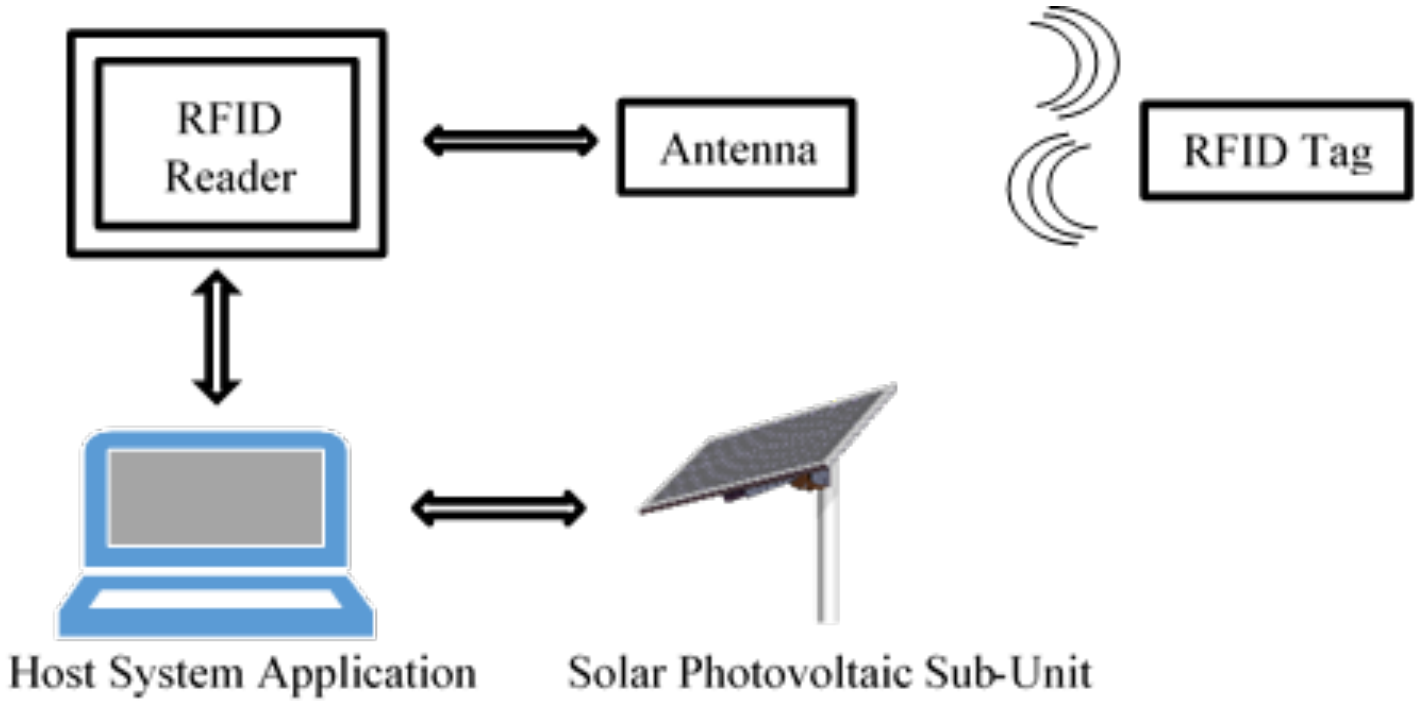

Figure 1: Block Diagram of Smart Park Management System

System Design Method (*Cont'd*)

- On getting to any of the parks, the tag is scanned by the RFID reader to ensure the eligibility of entry.
- For better efficiency, the UHF RFID reader is re-engineered to accommodate LPWAN wireless communication network, and powered by SPV system.
- Unauthorized vehicles are denied access.

System Design Method (*Cont'd*)

- Automated barriers are installed at the parks, and alternative exit routes are provided for unauthorized vehicles in order to reduce traffic congestion.
- Vehicle information are transmitted via wireless data links using LoRa LPWAN to a host system application at the SPV-powered central database management system for further processing and access control.

System Design Method (*Cont'd*)

- The UHF RFID reader system was re-engineered, as shown in Figure 2, to avoid the need of personal computer at each access point.
- Instead, a wireless LoRa LPWAN transceiver module is embedded in each of the reader to enable seamless interconnection of all the readers within the city.

System Design Method (*Cont'd*)

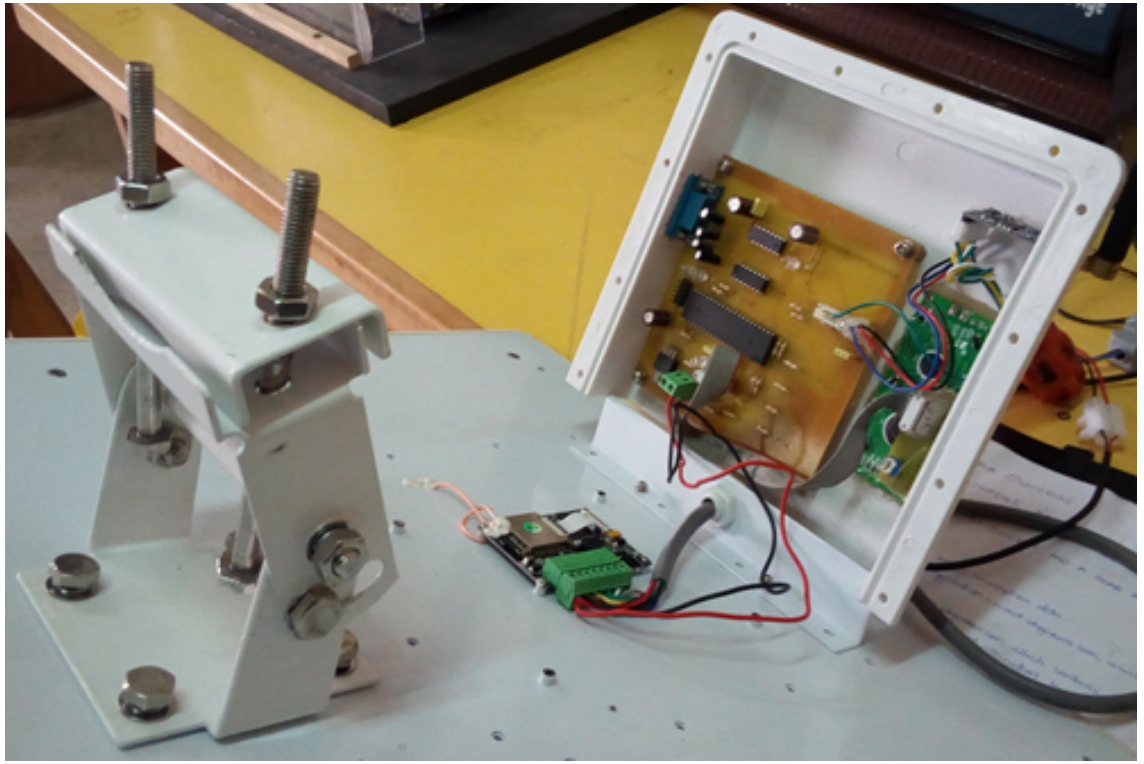

Figure 2: Re-engineered UHF RFID Reader

System Implementation

- Large RFID readers were installed at the entry points to all the parking lots.
- The readers were strategically positioned beside the road leading to those areas.
- The SPV system powers the combined reader antenna and wireless data communication system.
  - As soon as a vehicle enters the RF zone of the reader, the information preloaded on the RFID tag located on/within the automobile data is read by the reader antenna as shown in Figure 3.

System Implementation (*Cont'd*)

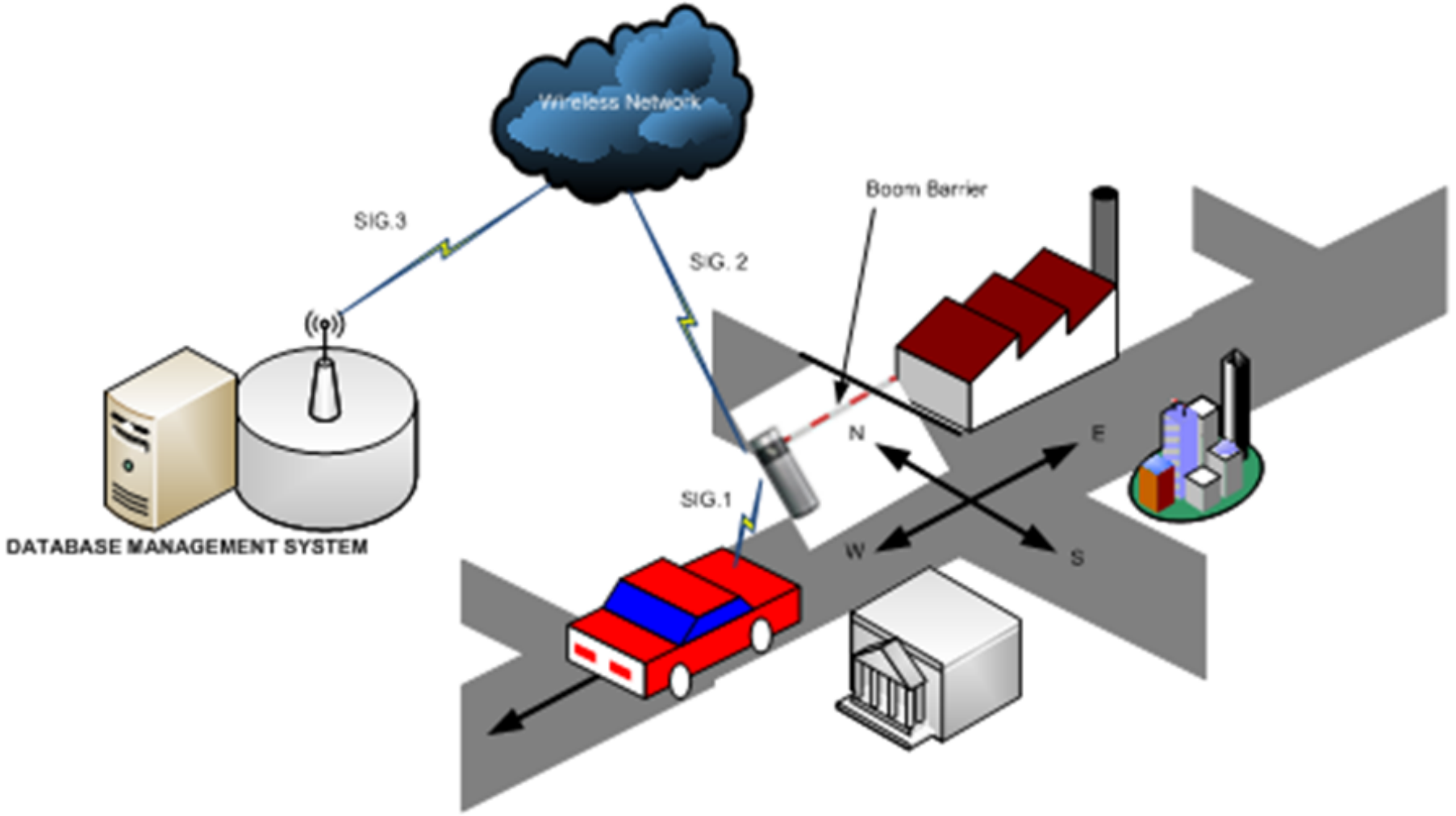

Figure 3: Use Case of Smart Traffic Management System

System Implementation (*Cont'd*)

- RF signals transmitted from every access points are received at the central control center and used for vehicle data matching and processing as required in vehicle identification, authorization, and authentication.
- A server-host application was developed using Java programming language and it runs on Windows operating system.

System Implementation (*Cont'd*)

- Vehicle information are logged using an open source database management software, MySQL.
- The server host application communicates with the MySQL database via MySQL.NET connector API.
- For sustainable power supply, a suitable SPV system was designed to power the logger PC.

Conclusion

- This work addressed the challenges of incessant traffic congestion in public places, especially during special occasions and events.
- The system was designed for eco-friendly vehicular traffic management in smart and connected communities to minimize the incidences of auto crashes, waste of time and resources, and release of more carbon into the ecosystem.

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