EN2130 - Course Project

Two-Way Digital Paging System Using Software Defined Radios

(40 Marks)

Project Objective

For this project, you will work in a group of four to design and implement a two-way digital paging system using **SDR**s. The system must support transmission of short text messages from one device to another, with proper addressing and acknowledgment mechanisms. You are expected to focus on reliable end-to-end communication, leveraging SDR platforms, GNU Radio, and MATLAB as key tools for system implementation and signal processing.

Expected Student Outcomes

By the end of the project, each group should be able to:

1. Understand and implement a functional digital communication system in SDR platforms.
2. Demonstrate a working two-way communication system over wireless.
3. Handle addressing, framing, acknowledgment, and reliable data delivery in a digital communication system.
4. Document the entire system: architecture, signal flow, protocol logic, and user interaction.
5. Reflect on system performance and suggest improvements.

Core Requirements

Each group must design and implement the following mandatory features:

- **Message delivery:** Short message delivery using digital modulation (BPSK/QPSK/etc.).
- **Unique user addressing:** Each receiver must only respond to messages intended for its address or ID.
- **Acknowledgment mechanism (ACK):** The receiver must send an acknowledgment upon successful message receipt.

- **Error Detection:** Add CRC-based error detection and discard corrupted messages.
- **Basic User Interface:** A simple console- or GUI-based interface to compose and send messages.

Optional Features

While not mandatory, implementing any of the following will be recognized as added merit:

- AES encryption for messages.
- Priority-based message handling (e.g., emergency vs. normal).
- Integration with external input hardware (e.g., ESP32 button trigger).
- Graphical interface simulating a hospital/emergency paging dashboard.

Tools and Platforms

- **Hardware:** BladeRF SDR (provided by lab).
- **Software:** GNU Radio (preferred), MATLAB/Simulink, Python (for interface logic), Wireshark, or any additional SDR-compatible open tools.
- **Programming Languages:** Python, MATLAB, or C/C++ (based on software stack).

Evaluation Criteria

The total evaluation will consist of three components:

1. Mid-Evaluation

Simulation Deliverables (to be demonstrated):

- Working simulation (GNU Radio/MATLAB) of message transmission and reception.
- Acknowledgment mechanism visible in simulation.
- Message addressing and CRC-based error checking logic.
- Clear explanation of the system design and software stack chosen.

Note: Hardware demonstration is not required at this stage.

2. Final Demonstration

- Working prototype using BladeRF (send and acknowledge message).
- Real-time messaging between two nodes.
- Proper framing, addressing, and CRC validation.
- Optional features, if implemented, will carry bonus marks.

Additional Notes

- All groups must conduct proper testing and validation before final demo day.
- Hardware will be allocated in slots; plan accordingly.
- Group collaboration, division of tasks, and time management will be assessed informally during reviews.

Note

This project emphasizes practical skills in communication system design. Students are encouraged to collaborate effectively, maintain detailed logs, and regularly consult with instructors for technical guidance.