Beacon Receiver and Beacon Transmitter

Embedded Systems Design – Mini Project

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Introduction

This project focuses on developing a LoRa-based wireless beacon transmitter and receiver system designed for emergency communication. The solution enables long-range, low-power alerts even when mobile networks fail during disasters such as floods and landslides. The system consists of a portable person tag and a base station that can send and receive SOS and beacon signals reliably.

Why this project?

Floods and landslides in Sri Lanka can damage infrastructure and disrupt networks

During disasters, mobile calls/SMS may fail (power outage, congestion, damaged towers)

Need a low-power, long-range communication method that works without cellular/internet

LoRa is suitable because it supports long range + low energy operation

Problem Statement

Problem

- People in disaster areas may become isolated and cannot send emergency alerts.

Need a system that:

- Works independently of existing network infrastructure.
- Can send status beacons + SOS alert reliably over long range.
- Helps responders with presence confirmation and last-contact time.

Proposed Solution

A LoRa-based wireless beacon system with 2 main units:

- **Beacon Transmitter** (Person Tag)
  - Periodically sends beacon message with unique ID.
  - SOS button sends emergency alert instantly
- **Beacon Receiver** (Base Station)
  - Continuously listens for LoRa messages
  - Based on distance LED bulbs alerts give rough idea about distance and when distance is low buzzer will trigger.

Technologies & Components

Hardware

ATmega328P (Tx + Rx controllers)

LoRa RA-02 / SX1278 modules + antennas

SOS push button, LEDs

Buzzer / siren

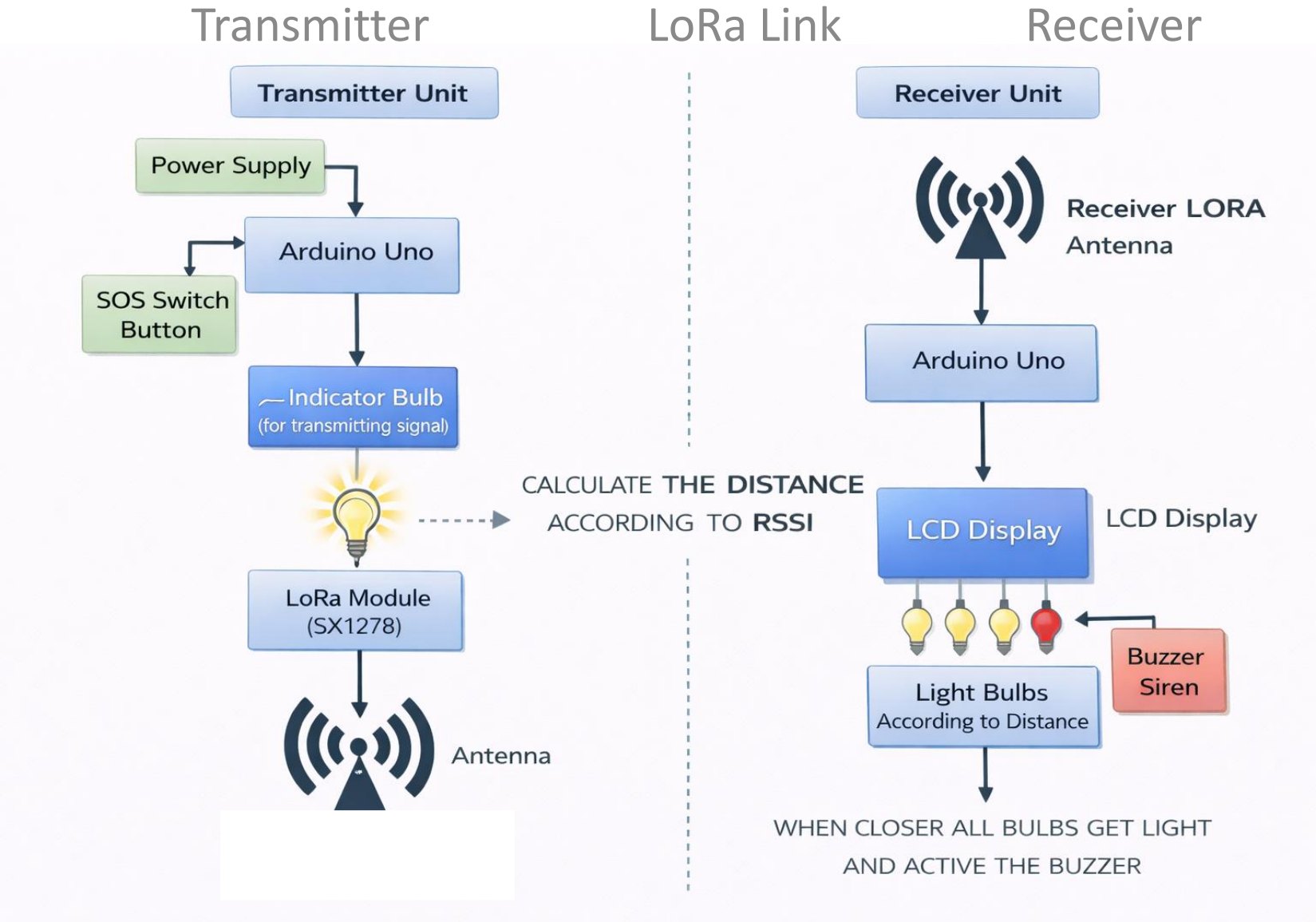
16x2 LCD display (receiver)

Software

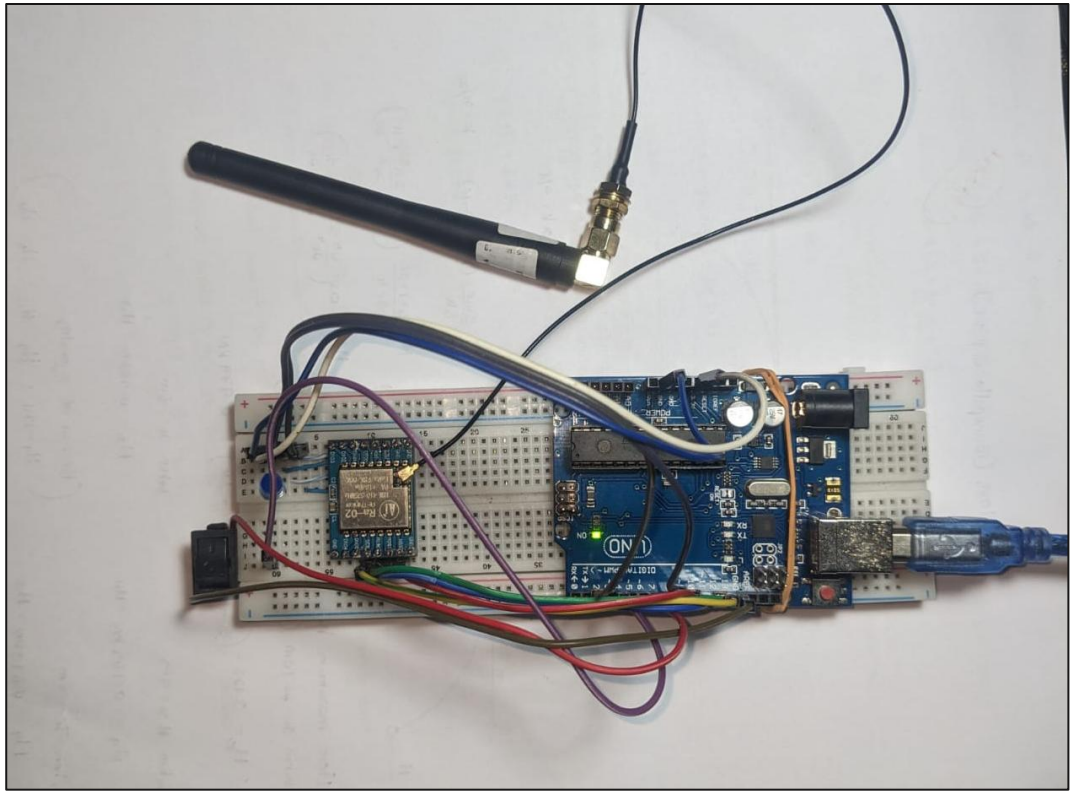
Embedded C / C++ for firmware

LoRa communication library for packet TX/RX and parameter setup

System Architecture



Beacon Transmitter (Person Tag)



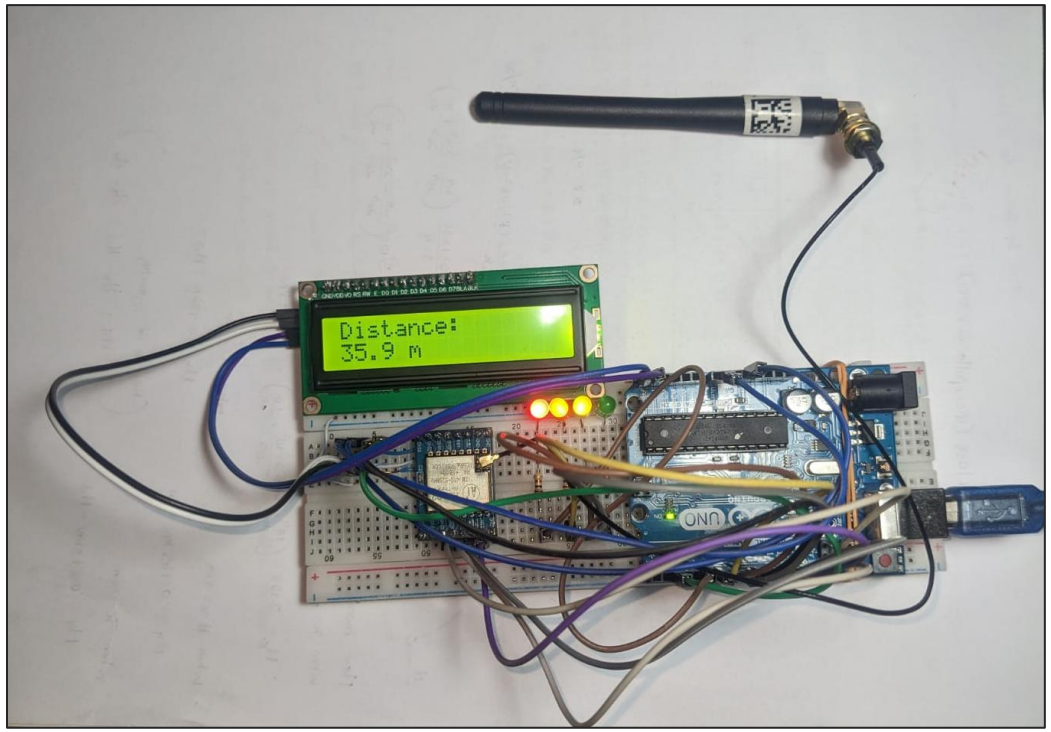
Internal Components:

- Arduino UNO
- LoRa RA-02 module
- SOS Push Button
- TP4056 Charging Module

Functions:

- Sends beacon message every few seconds
- Sends SOS alert when button pressed
- Powered by rechargeable battery

Beacon Receiver (Base Station)



Internal Components:

- Arduino UNO
- LoRa Receiver Module
- LED Indicators (to show distance alert levels)
- Buzzer (for SOS or critical distance)
- Optional LCD Display

Functions:

- Continuously listens for beacon packets
- Determines distance roughly using RSSI
- Visual and audio alerts

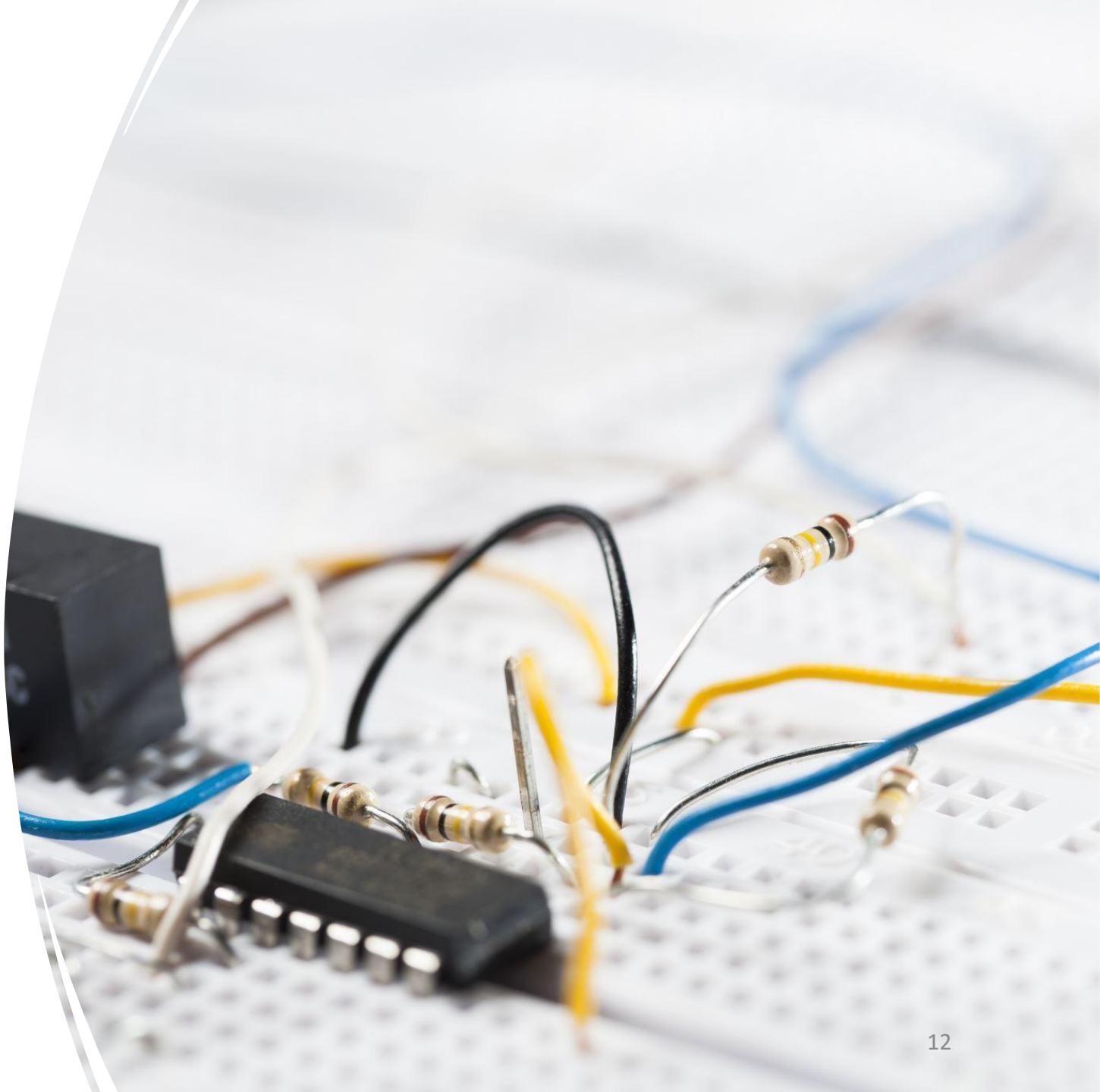
Challenges We Faced

- Difficulty understanding **LoRa configuration parameters** (frequency, SF, bandwidth)
- **RSSI values not stable**, making distance estimation challenging
- LoRa cannot determine **exact distance** because RSSI is affected by multipath propagation, interference, and obstacles.
- Initial breadboard wiring issues
- LoRa communication failed until SPI wiring was corrected
- Limited testing space for long-range communication

Prototype Progress

Completed:

- Breadboard simulation for both transmitter & receiver
- LoRa communication tested successfully
- SOS button working
- LEDs & buzzer tested with receiver signals
- Initial code debugging done



Timeline

Task	Week														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Literature review and requirement analysis															
Component selection and system planning															
Project Proposal Submission															
Simulation setup and testing															
Final simulation and design validation															
Hardware Development															
Software Development															
System testing and debugging															
Performance evaluation and optimization															
Final prototype completion and demonstration															

Budget

Required Components	Quantity	Cost Estimation
Atmega328p-PU Microcontroller	2	Rs.1700.00
IPEX to SMA Cable WIFI 3G 4G GSM Female Wire 30cm	2	Rs.460.00
Lora Ra-02 SX1278 Module	2	Rs.3000.00
LED (Approx 10 pcs)		Rs.50.00
5V mini Buzzer	1	Rs.40.00
RF 433MHz Antenna	2	Rs.560.00
Total Cost		Rs.5810.00

Conclusion

- LoRa provides a **reliable emergency alert mechanism**
- System works **independent of mobile networks**
- Current simulation shows system is functioning correctly
- Prototype development is on track for hardware implementation
- Helpful for disaster rescue operations

Group Members

- 2022/E/122 – RATHNAYAKE R.G.R.M.D.R
- 2022/E/175 – WEERASEKARA W.M.S.G.
- 2022/E/177 – SANDARUWAN W.P.P.C.
- 2022/E/179 – SUPUNTHAKA W.H.S.S.
- 2022/E/180 – PRASANJANA W.T.

THANK YOU