Beyond Cellular: Smartwatches with Satellite Communication for Critical Health Alerts

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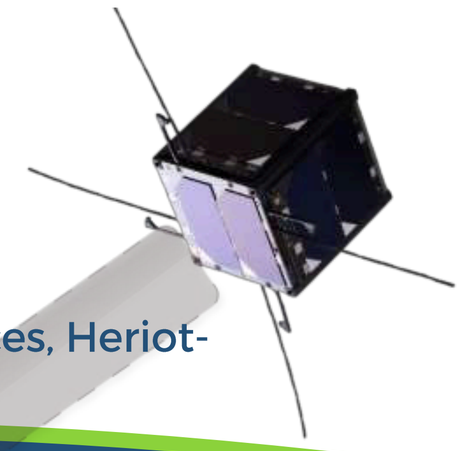


Abstract

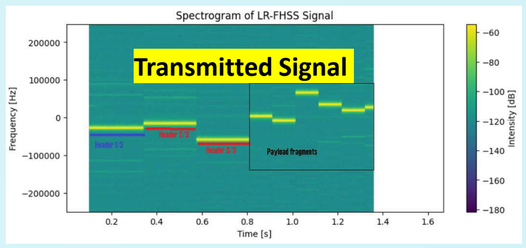
Access to emergency communication and healthcare in remote areas can save lives. Our research shows how smartwatches with satellite-based communication can send SOS alerts and health updates when mobile networks fail. Using Long Range Frequency Hopping Spread Spectrum (LR-FHSS), the watch connects over long distances without relying on towers. Ideal for hikers, emergency responders, and rural residents, it's built on the open-source ZSWatch platform and does efficient battery use. It tracks health, detects emergencies, and alerts caregivers—boosting safety, telemedicine, and remote care wherever you are.

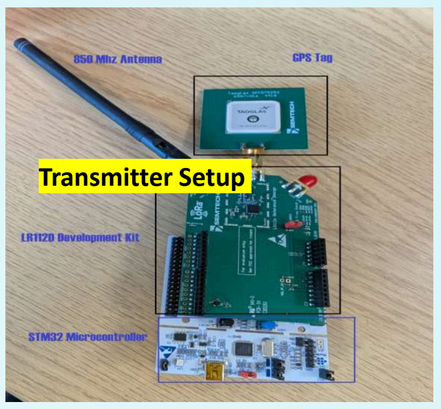
LR-FHSS Communication Background

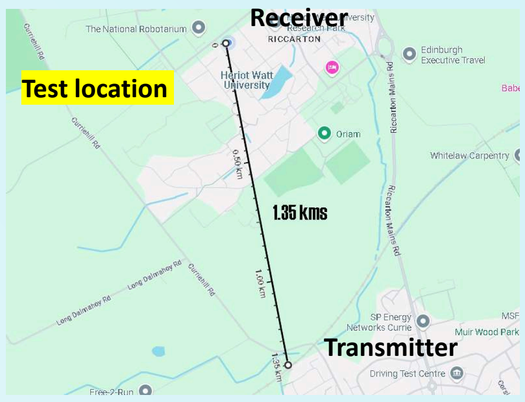
1. Long-range, low-power IoT needs:
   - Relieve **network congestion**.
   - Need for **energy-efficient** solutions.
2. Necessity:
   - **Long range, low power**, and **high scalability**.
3. Solution: LR-FHSS:
   - **Interference resistance**.
   - **Ultra-low power** and **long-range**
   - Works well in **environments with obstacles**

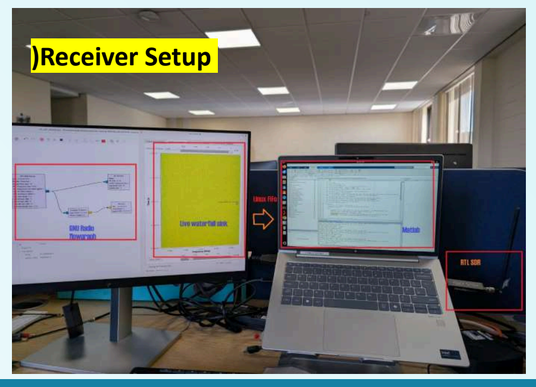
Custom Low Cost Receiver

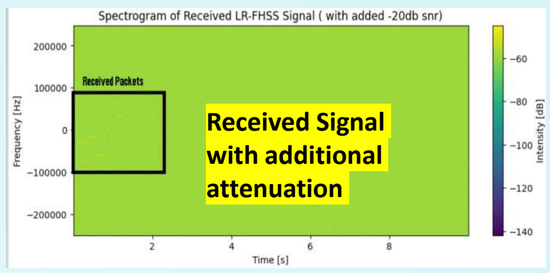
1. **Receiver:** low cost software defined radio - RTL SDR (Cost: 18$).
2. **Software:** Linux + GNU Radio + MATLAB.
3. **Low bit-rate communication**
4. **Tested over 1 km** with additional signal attenuation at receiver for simulation.



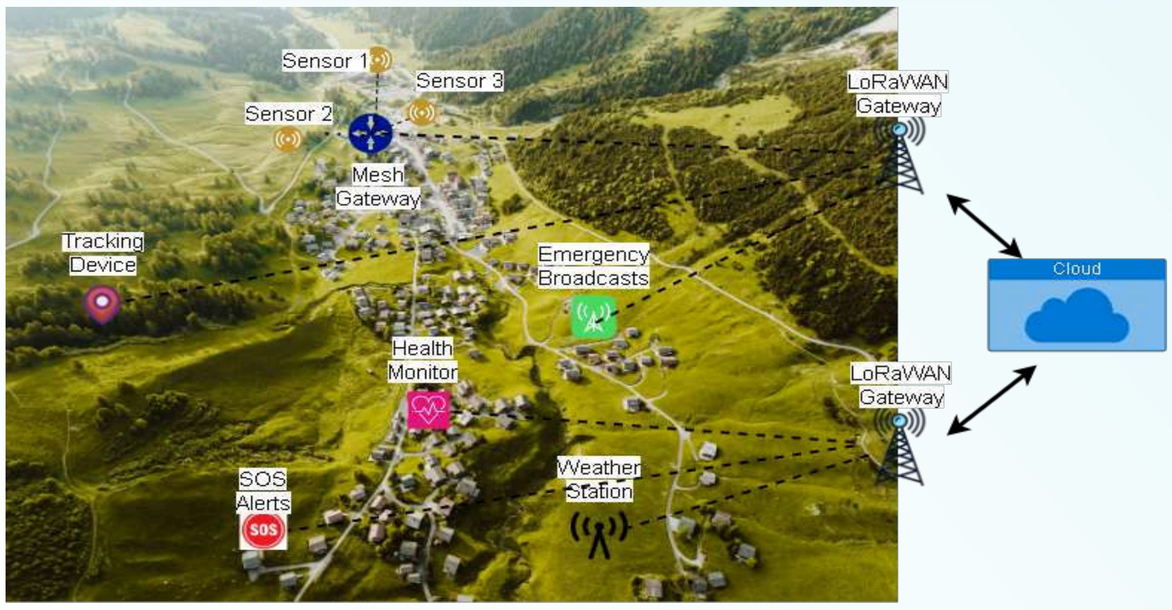


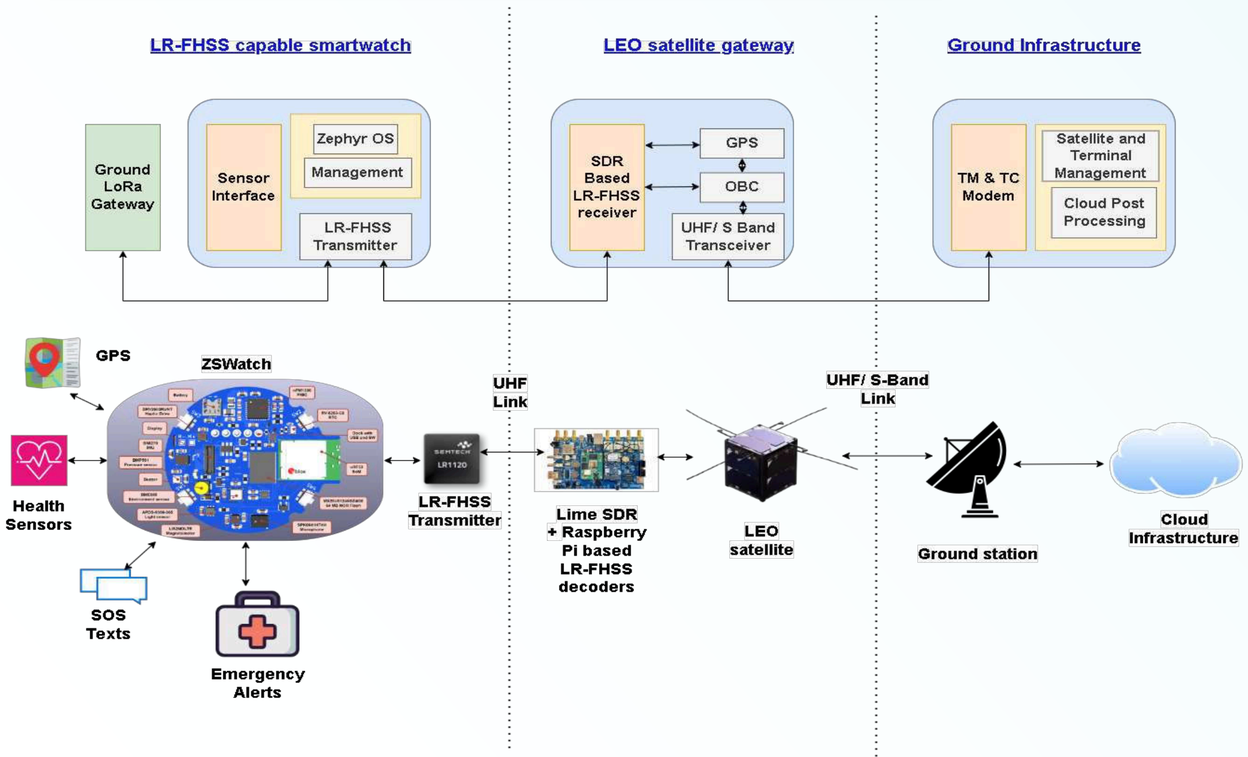






Methodology





Comparison Table

Feature	This work	LoRa CSS	5G	Wi-Fi/ Bluetooth
Range	10-15 km (Rural), 300-600 km (LEO)	10-15 km	500m – 10 km	50-300 m (BLE 1 km)
Power	Very low	Very low	High	Moderate-high,low (BLE)
Data Rate	0.3-50 kbps	0.3-50 kbps	Up to 10 Gbps	WiFi upto 9.6 Gbps, Bluetooth 1-24 Mbps
Capacity	High	Low	High (infra-dependent)	Moderate
Cost	Low (unlicensed)	Low	High	Moderate

Future Work

- Low cost embedded hardware based integrated receiver.
- Demonstration of connectivity over higher distances. (Weather ballon)
- Otimize the SDR based decoder algorithm.
- Open source existing work and collaborate with more developers.

References

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