Real Time Bus Arrival Monitoring System for Central Bus Station using Lora

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Abstract:
Public bus service is one in all the foremost reasonable means that of transportation by majority of peoples to travel from place to place in the town area. The service in rural areas is not as frequent as like in the town area and the arrival time is unsure. This has caused inconveniences to the passengers. They are suffering and waiting for bus on their station for while since, they don’t have updated real time information about their bus arrival. The foremost of the time wasted by the individuals is on awaiting for buses on the bus stations that is actually frightful. Here, a convenient and economical bus arrival info system is needed to provide services for the communities. So, it becomes essential to trace the buses real location using GPS and provide passengers foretold time of bus inward at the bus station and conjointly individuals should get the bus like where the bus is, is it in traffic. The proposed idea focuses on the implementation of a Real Time bus arrival monitoring system for central bus station by using Lora module. By putting in, LoRa module in central bus station observance unit and fixing LoRa module with GPS device on town buses. Bus unit can monitor the present GPS location and alternative information about the bus and therefore the central observance unit will monitor the bus arrival timing and other info about the bus. The proposed system that provides a real-time info concerning the current situation and calculable time of arrival of the buses.

Keywords: LoRa; Bus unit; Central bus monitoring unit; GPS; Bus location.

1. INTRODUCTION
In daily operation Buses are the main transport systems for the peoples. The movement of vehicles is affected by different uncertain conditions as the day progresses such as traffic congestion, unexpected delays, randomness in passenger demand, irregular vehicle-dispatching times and incidents. Many passengers are often late to work, students are late for classes because they decide to wait for the bus instead of just simply using an alternate transportation. The required solution should not only facilitate improvement in the services, but also be a driving factor for increase the trust on the public bus transport systems. Reliability in public transport will be facilitated when the traveller accurately knows when a bus will arrive to the bus stop or when will the bus reach the bus station. Buses are difficult to operate on time due to weather and traffic congestion, and bus users want to know the current location and expected arrival time of the bus. One solution to this problem is the bus location system. The proposed system identifies the real time location of the buses to calculate the estimated time for reaching a particular position. By transmitting the current GPS location data to the control unit using LoRa along with corresponding bus information’s, we can estimate the time for the bus to arrive a bus stop, or time to reach a bus station, using services. This system presents a simple and cost effective solution to make public transportation services ‘smart’. The system will present the concept, technology stack, components and the outcomes of implementing the solution. The primary goal of the proposed solution is to minimize the costs involved in implementation and to create a backend that can scale up easily with increase in demand. The location data collected from the buses should be accessible by central bus control unit and to the passengers.

2. PROPOSED SYSTEM
The Real Time bus arrival monitoring system for central bus station by using Lora module is proposed with the assistance of recent LoRa WAN technology as shown in the figure 4.1. In the existing systems, GSM and Web server applications are used for observance. The LoRa module could be a Class A protocol allows wireless connectivity to any LoRa WAN module in network infrastructure, whether public or privately deployed. The module is specifically designed for easy use, that shortens development time and network connectivity. LoRa technology is good for battery operated sensors and low power applications like IoT, vehicle tracking, Smart City, Sensor networks, Industrial automation and more.

Figure.2.1. Block Diagram of Proposed System
3. REAL TIME BUS TRACKING USING GPS

GPS receiver is used to identify the current location. Location provided by GPS within the bus unit isn’t in human understandable format. This data need to be processed to convert it into useful information. The data provided by the GPS receiver is taken by the central processor and process the required location information. When all required information is extracted and processed, it has to be transmitted to a oversea receiver to display this information to the bus station. GPS (Global Positioning System) antenna get signals from GPS satellites and it should face towards sky for proper computation of the current location by GPS receiver. The location information is transferred to LoRa Module through serial interface. Then processing of the data provided by GPS receiver, LoRa Module transmit the information to central bus unit.

4. RN2903A

The RN2903 transceiver module features LoRa Technology RF modulation, which provides long range spread spectrum communication with high interference immunity. Using LoRa Technology modulation technique, RN2903 can achieve a receiver sensitivity of -146 dBm. The high sensitivity combined with the integrated +18.5 dBm output power amplifier yields industry leading link budget, which makes it optimal for applications requiring extended range and robustness. LoRa Technology modulation also provides significant advantages in both blocking and selectivity compared to the conventional modulation techniques, solving the traditional design compromise between extended range, interference immunity, and low-power consumption. The RN2903 module delivers exceptional phase noise, selectivity, receiver linearity, and IIP3 for significantly lower power consumption. The level of conductive harmonics is below -70 dBm. Figure 4.2, Figure 4.3 and Figure 4.4 show the top view, the pin out, and the block diagram of the module. This module consist of two main units. They are

- SX1276 RF Module
- PIC18lf46k22 Pic-microcontroller

4.1 SX1276

The SX1276 incorporates the LoRa spread spectrum modem which is capable of achieving significantly longer range than existing systems based on FSK or OOK modulation. At maximum data rates of LoRa the sensitivity is 8dB better than FSK, but using a low cost bill of materials with a 20ppm XTAL LoRa can improve receiver sensitivity by more than 20dB compared to FSK. LoRa also provides significant advances in selectivity and blocking performance, further improving communication reliability. For maximum flexibility the user may decide on the spread spectrum modulation bandwidth (BW), spreading factor (SF) and error correction rate (CR). Another benefit of the spread modulation is that each spreading factor is orthogonal - thus multiple transmitted signals can occupy the same channel without interfering. This also permits simple coexistence with existing FSK based systems. Standard GFSK, FSK, OOK, and GMSK modulation is also provided to allow compatibility with existing systems or standards such as wireless MBUS and IEEE 802.15.4g. The SX1276 and SX1279 offer bandwidth options ranging from 7.8 kHz to 500 kHz with spreading factors ranging from 6 to 12, and covering all available frequency bands. The SX1277 offers the same bandwidth and frequency band options with spreading factors from 6 to 9. The SX1278 offers bandwidths and spreading factor
options, but only covers the lower UHF bands. The following figure shows a simplified block diagram of the SX1276. SX1276 is a half-duplex, low-IF transceiver. Here the received RF signal is first amplified by the LNA. The LNA inputs are single ended to minimize the external BoM and for ease of design. Following the LNA inputs, the conversion to differential is made to improve the second order linearity and harmonic rejection. The signal is then down-converted to in-phase and quadrature (I&Q) components at the intermediate frequency (IF) by the mixer stage. A pair of sigma delta ADCs then performs data conversion, with all subsequent signal processing and demodulation performed in the digital domain.

![Figure 4.1.1 Pin Diagram of SX1276](image)

### 4.2. Block Diagram of PIC18LF46K22

**PIC18LF46K22 MICROCONTROLLER**
The PIC18(L)F46K22 microcontrollers offers the advantages of high computational performance at an economical price – with the addition of high-endurance, Flash program memory. On top of these features, family introduces design enhancements that make these microcontrollers a logical choice for many high performances, power sensitive applications as shown in the block diagram 4.2.

### 4.3 LORA Modem

The LoRa modem uses a proprietary spread spectrum modulation technique. This modulation, in contrast to legacy modulation techniques, permits an increase in link budget and increased immunity to in-band interference. At the same time the frequency tolerance requirement of the crystal reference oscillator is relaxed - allowing a performance increase for a reduction in system cost.

#### 4.3.1 Spreading Factor:
The spread spectrum LoRa modulation is performed by representing each bit of payload information by multiple chips of information. The rate at which the spread information is sent is referred to as the symbol rate, the ratio between the nominal symbol rate and chip rate is the spreading factor and represents the number of symbols sent per bit of information. The ranges of values accessible with the LoRa modem are shown in the following table 4.3. That the spreading factor must be known in advance on both transmit and receive sides of the link as different spreading factors are orthogonal to each other. Also the resulting signal to noise ratio (SNR) required at the receiver input. It is the capability to receive signals with negative SNR that increases the sensitivity, so link budget and range, of the LoRa receiver.

#### 4.3.2 Signal Bandwidth:
An increase in signal bandwidth permits the use of a higher effective data rate, thus reducing transmission time at the expense of reduced sensitivity improvement. There are of course regulatory constraints in most countries on the permissible occupied bandwidth. Contrary to the FSK modem which is described in terms of the single sideband bandwidth, the LoRa
modem bandwidth refers to the double sideband bandwidth (or total channel bandwidth).

4.3.3 LoRa Packet Structure:
The LoRa modem employs two types of packet format, explicit and implicit. The explicit packet includes a short header that contains information about the number of bytes, coding rate and whether a CRC is used in the packet. The packet format is shown in the following figure 4.7. The LoRa packet comprises three elements:

- A preamble.
- An optional header.
- The data payload.

Figure 4.2 Packet Format of LoRaModu

5. SIMULATION CIRCUIT FOR PROPOSED SYSTEM USING LORA RN2903A

The simulation is done with working flow of proposed system. The information about bus is transmitted from bus unit using LoRa module and the data has been received by the central monitoring unit using LoRa module. The system data has been displayed with the help of terminals displays on the Proteus simulation tool and the simulation output has been obtained.

Figure 5.1. Simulation Circuit of Proposed System

5.3. SIMULATION OUTPUT
6.CONCLUSION

This project presents on the implementation of Real Time bus arrival monitoring system for central bus station by using Lora module. By putting in, LoRa module in central bus station observance unit and fixing LoRa module with GPS device on town buses. Ready to monitor this GPS location and other alternative information regarding the bus and therefore, the central station observance unit will monitor the bus arrival temporal order and other information about the bus. Thus, the bus monitoring information has successfully obtained with Simulation and the results are satisfied.

7.FUTURE WORK

The performance of this proposed system can also be improved by implementing LoRa repeaters method on all buses in the corresponding bus stations and in central bus stations to reduce data loss.

8.REFERENCES


