PROJECT REPORT

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TITLE: Water Level Detector in an overhead tank based on LoRa Transceiver

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ABSTRACT:

Water Level Sensor gives information about the level of water in the water tank. Hence, any user can identify the level of water. LoRa long range modem provides ultra-long range spread spectrum communication and high interference to noise whilst minimizing the current consumption . LoRa based communication for a water level detector provides long range, low power bit rates which is optimal for every user.

WORK DONE:

Literature Related to the Following have been studied:

*Datasheet Sx1272IC
*Programming 8bit Atmel Atmega328p microcontroller
*Serial communication between MCU and PC

Programmed Atmel Atmega328P using Atmel Studio as Transmitter and Receiver

Established a Serial Communication between MCU and PC using Node.js

Literature Review:

Lora Sx1272 IC data sheet by SEMTECH is detailed enough to understand its architecture, configuration and SPI interface and Atmega328p data sheet is helpful to program Arduino. Nodejs tutorials enabled me to write script to establish serial communication between MCU and PC.

System Design:

One of the two LoRa nodes acts as receiver and the other one acts as transmitter which is at overhead tank.

The user who needs to see the level of water is required to push the button provided at the receiver end. Transmitter receives the signal and measures water level using ultrasonic sensor and returns the information to the receiver. The user can then see the water level in PC by executing Nodejs script

Ultrasonic Sensor:

Ultrasonic sensor used here is HC-04 which has a range of 4cm to 400cm. The ranging accuracy can reach up to 3mm and works at a frequency of 40Hz.

Working Principle:

1)The trigger pin of sensor should be set high for at least 10us.

2)The module then automatically sends eight 40Hz and sets Echo pin.

3)If the signal is received back by hitting an object echo pin resets.

By measuring the time window of echo pin going high we can measure the distance of object from the sensor as

Distance = high level time * speed of sound(340m/s)/2

High level time is captured using ICP0 pin of Arduino which captures the input signal.

SPI Communication:

SX1272 IC is manipulated for different configurations and data transmission or reception using SPI communication between microcontroller(Arduino) and SX1272.

The SPI interface gives access to the configuration register via a synchronous full-duplex protocol corresponding to CPOL = 0 and CPHA = 0 in Motorola/Freescale nomenclature. Only the slave side is implemented.

Three access modes to the registers are provided:

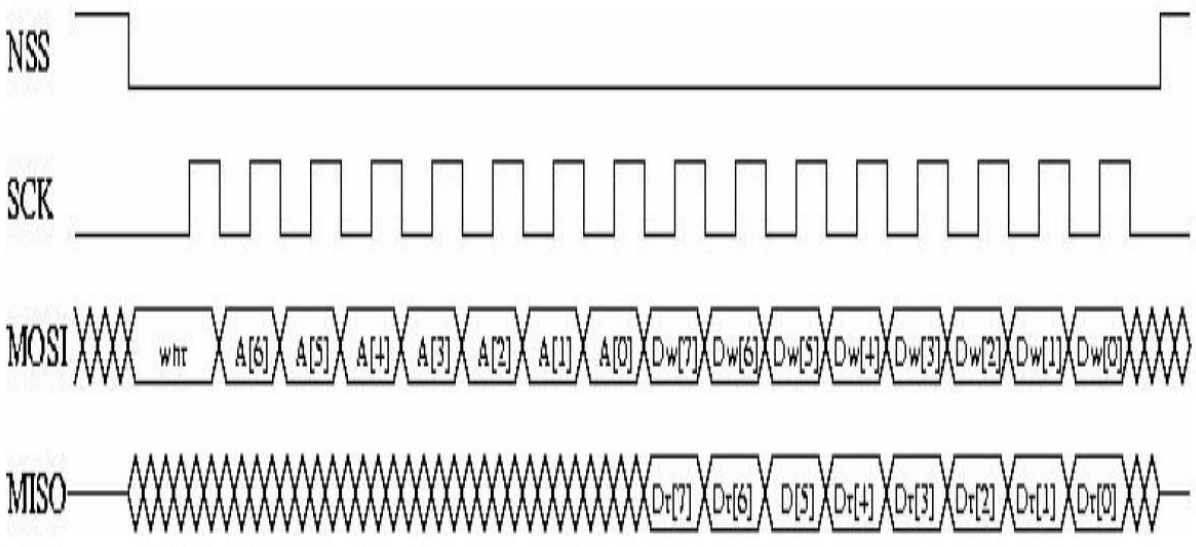
i. SINGLE access: an address byte followed by a data byte is sent for a write access whereas an address byte is sent and a read byte is received for the read access. The NSS pin goes low at the beginning of the frame and goes high after the data byte.

ii. BURST access: the address byte is followed by several data bytes. The address is automatically incremented internally

between each data byte. This mode is available for both read and write accesses. The NSS pin goes low at the beginning of the frame and stay low between each byte. It goes high only after the last byte transfer

iii. FIFO access: if the address byte corresponds to the address of the FIFO, then succeeding data byte will address the FIFO. The address is not automatically incremented but is memorized and does not need to be sent between each data byte. The NSS pin goes low at the beginning of the frame and stay low between each byte. It goes high only after the last byte transfer.

The figure below shows a typical SPI single access to a register



A transfer is always started by the NSS pin going low. MISO is high impedance when NSS is high.

The first byte is the address byte. It is comprises:

The second byte is a data byte, either sent on MOSI by the master in case of a write access or received by the master on MISO in case of read access. The data byte is transmitted MSB first.

*A wnr bit, which is 1 for write access and 0 for read access.

* Then 7 bits of address, MSB first.

SX1272 LoRa Modem:

Transmitter end: The transmitter side of LoRa is kept in CAD mode to reduce power consumption. It measures the water level using Ultrasonic sensor, creates a packet by adding header and CRC check bits to the payload.

Receiver end: This processes the received packet extract data from payload and display it to the user through serial communication between MCU and PC

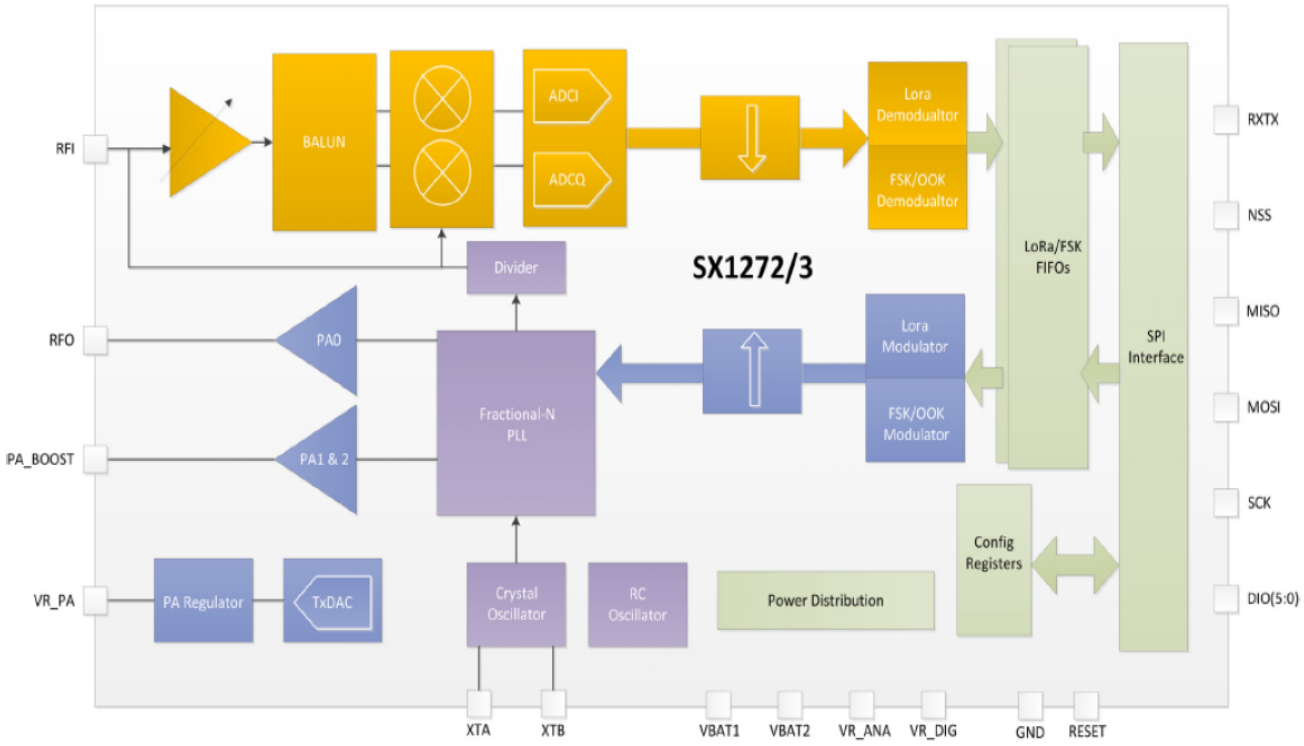
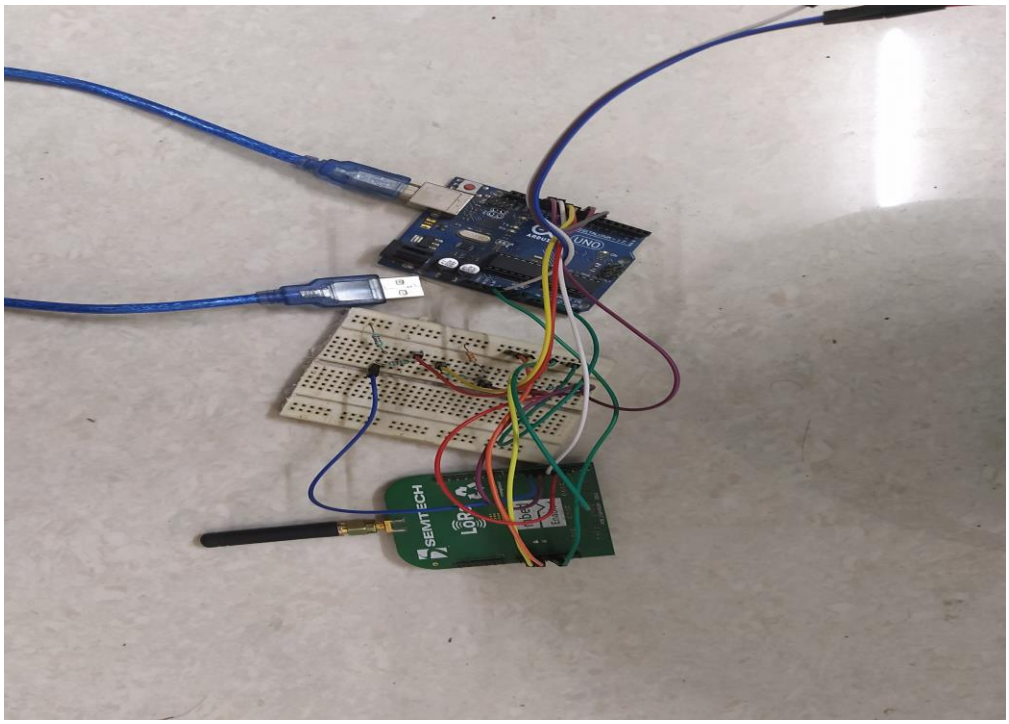


Figure 1. SX1272/73 Block Diagram

Results:

The following systems have been built and tested:

A)LoRa configuration at transmitter end



B)Ultrasonic sensor at transmitter end:

C)Reception of information at receiver end: