Progress Presentation-I

e-Yantra Summer Internship-2018

LowCostSensorNode / SensorNetworkDevelopmentPlatform

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Overview of Project

- Project Name :- Low Cost Sensor Node / Sensor Network Development Platform
- Objective
  - A custom built power supply for optimized for low power sensor node applications
  - Ability to program via Arduino IDE/ Atmel Studio
  - Use NRF2401 for RF communication
  - Completely open source design and sample codes to make it useful for WSNs
  - Can be used as general purpose microcontroller board for learning interfacing and C programming
- Deliverables
  - A sensor node platform along with sample codes for rapid prototyping
  - A firmware for low power modes and nRF24L01 networking
  - Documenation on Hardware and Software

Overview of Task

Task No.	Tasks	Deadline
1	Study about different sensor nodes platform available and their USP. Take desirable aspects of each	1 day
2	Review low power modes in Atmega328p, NRF2401 literature review	1 day
3	Build prototype using arduino pro mini + NRF2401, test range theoretically and experimentally in outdoor environment	2 day
4	Research components available and select to fit price vs performance metric	2 days
5	Build pcb design, source components, evaluation in proteus (if necessary)	5 days
6	Prototype soldering and testing	2 days
7	Building a network of 3 nodes, relaying info, power consumption analysis	5 days
8	Making reusable firmware for NRF2401, interfacing soil moisture, temperature/humidity sensors	4-5 days
9	Loading tiny OS, initial experiments	2 days
10	Trying out the features available in tiny OS, feasibility check	3 days
11	Firmware documentation, hardware manual and reporting results	3 days

Task Accomplished

- Study of Atmega328p datasheet
- Wireless module
  - XBee (250 Kbps, 1.2 km, Rs. 1158)
  - Bluetooth (1 Mbps, 10 m,Rs. 250)
  - nRF24L01 (2Mbps, 100 m, Rs. 100)
- Study of RF24 library with useful APIs
- Successfully uploaded bootloader on Arduino Pro Mini
- Selected components for circuit design
  - LDO (MIC5219)
  - Boost converter (FP6291)
  - Mosfet (PMV65XP)

Task Accomplished

- Prototype hardware for range testing

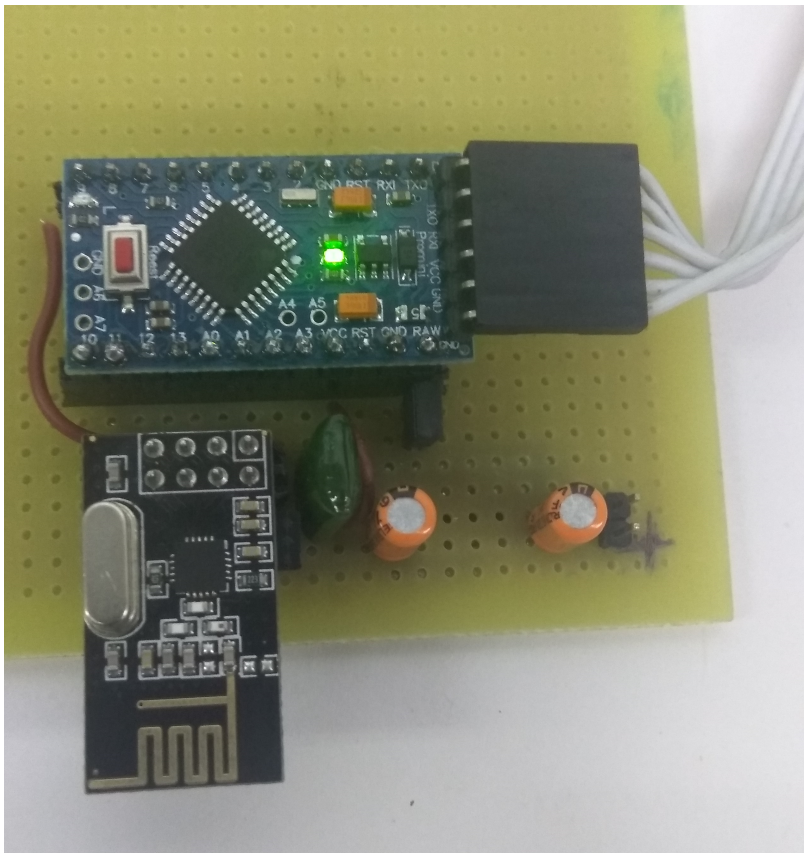

Figure: 1. Prototype Hardware

Task Accomplished

- PCB design of final circuit

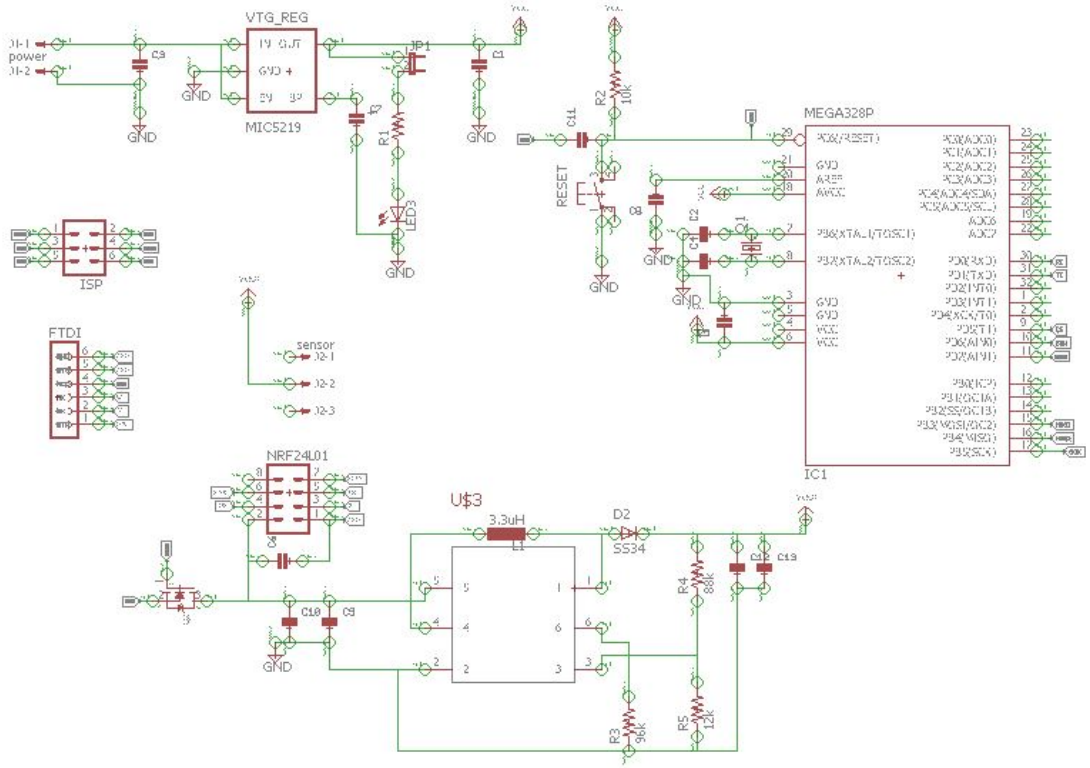

Figure: 2. Schematic design of board

Task Accomplished

- Completed testing of star network by using two transmitter and one receiver.
- Measure current of Arduino Pro Mini
  - Normal mode current = **11.5 mA**
  - Sleep mode current =**0.6 mA**
- Measure current of nRF24L01
  - Normal mode current = **1.2 mA**
  - stand by mode current = **40 uA**
  - Sleep mode current = **900 nA**
- Test the range of nRF24L01 in outdoor environment with different data rate.
  - MIN (-18dBm) power = **0 to 6 m**
  - LOW (-12dBm) power = **0 to 8 m**
  - HIGH (-6dBm) power = **0 to 12 m**
  - MAX (0dBm) power = **0 to 16 m**

Task Accomplished

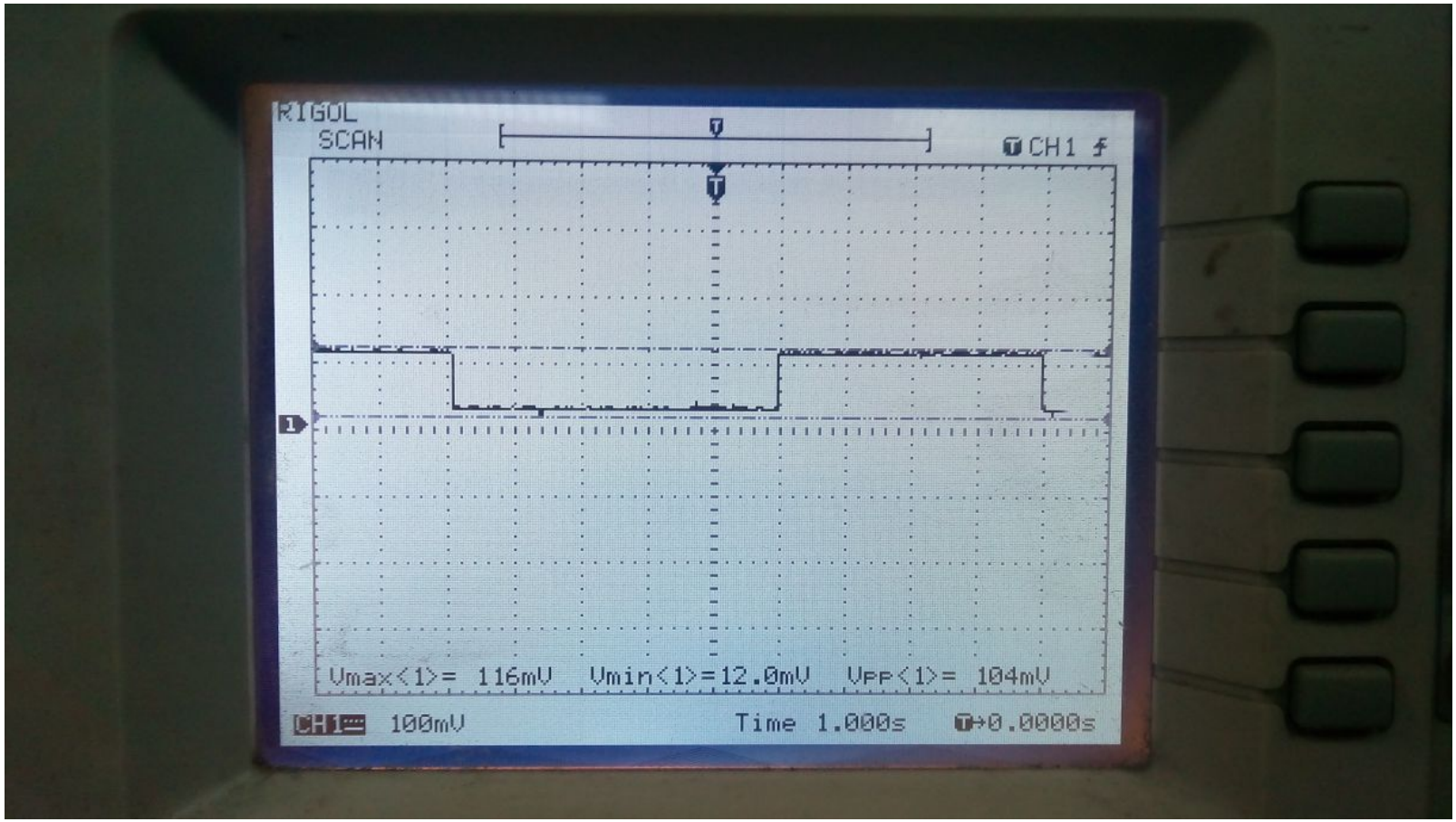

Figure: 3. Current of Arduino Pro Mini (Sleep mode, Idle mode)

Task Accomplished

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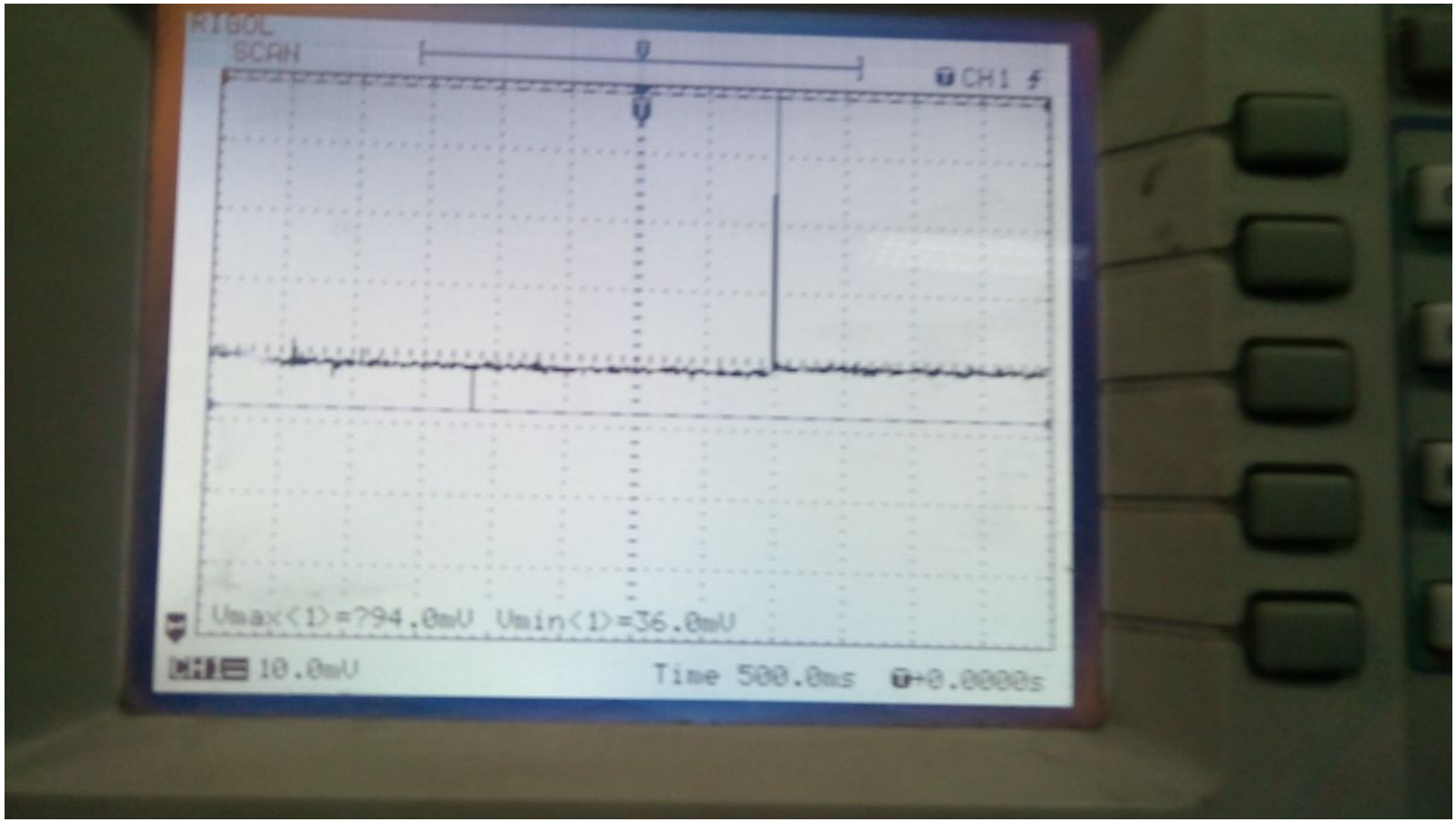

Figure: 4. Current of nRF24L01 (Active mode, Sleep mode)

Table: Range testing of nRF24L01(At different data rate)

Transmission Power level Distance (meter)	MIN power (-18 dBm)	LOW power (-12 dBm)	HIGH power (-6 dBm)	MAX power (0 dBm)
3.8	100%	100%	100%	100%
4.9	100%	100%	100%	100%
5.9	100%	100%	100%	100%
6.9	47%	100%	100%	100%
8	0%	100%	100%	100%
8.2	0%	100%	100%	100%
10	0%	74%	100%	100%
12.4	0%	0%	100%	100%
15.6	0%	0%	86%	100%

Challenges Faced

- Prototype testing of nRF24L01.
- Range testing of nRF24L01 in outdoor environment.
- Setting of fuse bits (Low, High, Extended) using AVRDude.
- Importing RF24 library in Atmel Studio.
- Differentiating data of two transmitter at one receiver.

Future Plans

- PCB printing, soldering and testing
- Solve the problem of RF24 library in Atmel. So, that we can make example codes for prototype
- Duty cycling of Atmega328p
- Study about RF24mesh library
- Setup of 5 nodes WSN star network
- Use Raspberry-pi as gateway connected to master
- Operating life prediction of WSN
- Add soil moisture,light intensity sensor,humidity sensor on board as examples sensors

Thank You

THANK YOU !!!