Progress Presentation-I

e-Yantra Summer Internship-2018
Low Cost Sensor Node

Sachin Jadhav
Nithin Thilakappan
Nishit Patel

Mentors:
Parin Chheda, Kalind Karia

IIT Bombay

June 7, 2018

Overview of Project

- **Project Name:** Low Cost Sensor Node
- **Objectives:**
  1. A custom built power supply for optimized for low power sensor node applications
  2. Ability to program via Arduino IDE/ Atmel Studio
  3. Use nRF2401 for RF communication
  4. Completely open source design and sample codes to make it useful for WSNs
  5. Can be used as general purpose microcontroller board for learning interfacing and C programming
- **Deliverables:**
  1. A sensor node platform along with sample codes for rapid prototyping
  2. A firmware for low power modes and nRF24L01 networking
  3. Documenation on Hardware and Software

Overview of Task

Task No.	Tasks	Deadline (in Days)
1	Study about different sensor nodes platform available and their USP. Take desirable aspects of each	1
2	Review low power modes in ATmega328p, nRF2401 literature review	1
3	Build prototype using Arduino Pro Mini and nRF2401, test range theoretically and experimentally in outdoor environment	2
4	Research components available and select to fit price v/s performance metric	2
5	Build PCB design, source components, evaluation in Proteus (if necessary)	5
6	Prototype soldering and testing	2
7	Building a network of 3 nodes, relaying info, power consumption analysis	5
8	Making reusable firmware for nRF2401, interfacing soil moisture, temperature/humidity sensors	4-5
9	Loading TinyOS, initial experiments	2
10	Trying out the features available in tiny OS, feasibility check	3
11	Firmware documentation, hardware manual and reporting result	3

Task Accomplished

- Study of ATmega328p datasheet
- Wireless module for communication
    1. XBee (250 Kbps, 1.2 km, Rs. 1158)
    2. Bluetooth (1 Mbps, 10 m, Rs. 250)
    3. nRF24L01 (2 Mbps, 100 m, Rs. 100)
- Study of RF24 library with useful APIs
- Successfully uploaded bootloader on Arduino Pro Mini
- Selected components for circuit design
    1. LDO (MIC5219)
    2. Boost converter (FP6291)
    3. MOSFET (PMV65XP)

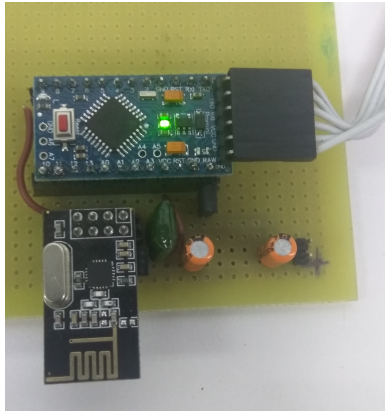# Task Accomplished

- Prototype hardware for range testing

Figure 1: Prototype Hardware

Progress
Presentation-I

Sachin Jadhav
Nithin
Thilakappan
Nishit Patel

Mentors:
Parin Chheda,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Challenges Faced

Future Plans

Thank You

Task Accomplished

- PCB schematic design of final circuit
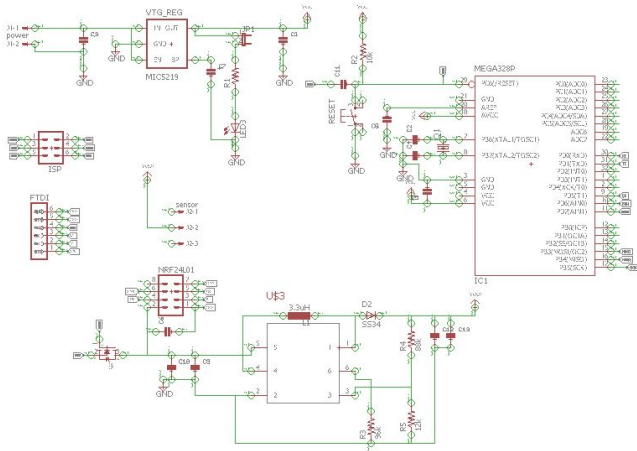
Figure 2: Schematic design of board

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 (-18 dBm) power = **0 to 6 m**
  - LOW (-12 dBm) power = **0 to 8 m**
  - HIGH (-6 dBm) power = **0 to 12 m**
  - MAX (0 dBm) power = **0 to 16 m**

Task Accomplished

Progress
Presentation-I

Sachin Jadhav
Nithin
Thilakappan
Nishit Patel

Mentors:
Parin Chheda,
Kalind Karia

Overview of
Project

Overview of Task

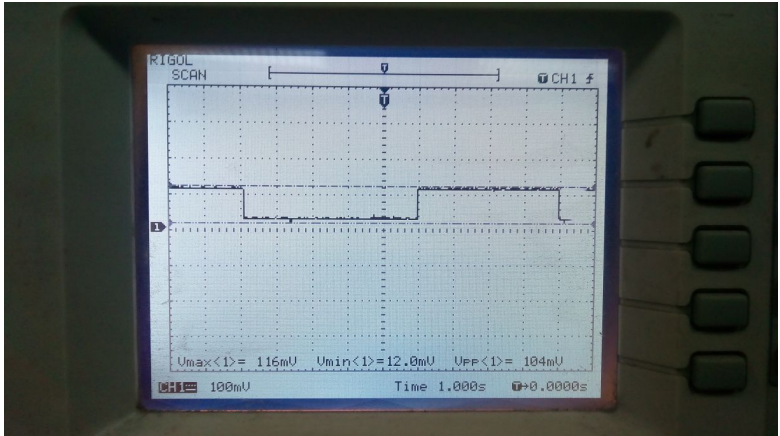Task
Accomplished

Challenges Faced

Future Plans

Thank You

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

Task Accomplished

Progress
Presentation-I

Sachin Jadhav
Nithin
Thilakappan
Nishit Patel

Mentors:
Parin Chheda,
Kalind Karia

Overview of
Project

Overview of Task

Task
Accomplished

Challenges Faced

Future Plans

Thank You

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

Progress
Presentation-I

Sachin Jadhav
Nithin
Thilakappan
Nishit Patel

Mentors:
Parin Chheda,
Kalind Karia

Overview of
Project

Overview of Task

Task
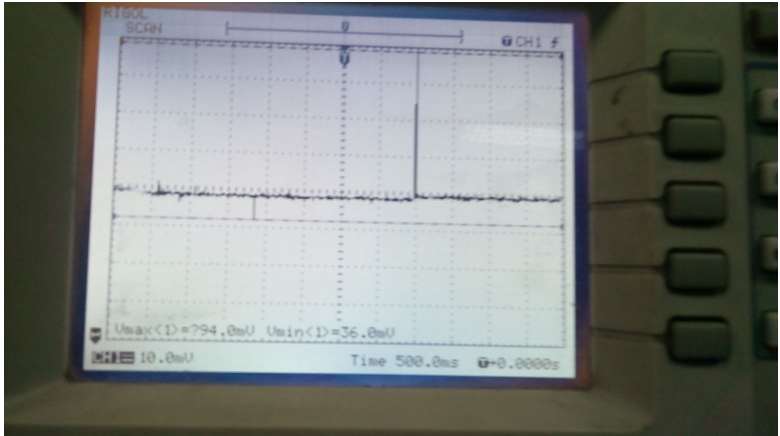Accomplished

Challenges Faced

Future Plans

Thank You

Table 1: Range testing of nRF24L01 (At different data rates)

Transmission Power level	MIN power (-18 dBm)	LOW power (-12 dBm)	HIGH power (-6 dBm)	MAX power (0 dBm)
Distance (meter)				
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 Studio, 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 RPi as a gateway connected to master
- Operating life prediction of WSN
- Add soil moisture, light intensity sensor, humidity sensor on board and make provision to connect other sensors if needed

Thank You

THANK YOU !!!