International Journal of Research in Advent Technology, Special Issue, March 2019
E-ISSN: 2321-9637
International Conference on Technological Emerging Challenges (ICTEC-2019)
Available online at www.ijrat.org

Remote Monitoring and Controlling of Greenhouse Agriculture Parameters Basedon LoRa

A.Gopala Sharma[1],Y.Stalin[2]A.Spandana[3], B.Bhavana[4]
Dept. Of Electronics And Communication Engineering Stanley College Of Engineering And Technology For Women
Stanley College Of Engineering And Technology For Women Hyderabad, Indiahyderabad, India
agopalasharma@stanley.edu.in, stalin@yagatek.comspandana.athota@gmail.com,bhavana3096@gmail.com

Abstract: In these days the communication is dependent on Internet of Things(IoT) application. Sending data to long range is because it consumes less power compared to other applications. "Remote monitoring and controlling of greenhouse agriculture parameters based on Long Range(LoRa) technology" based on measuring the parameters like Temperature, humidity, carbon monoxide and light by sensors which are located in different places in greenhouse. A greenhouse is covered area where plants grow and cultivate. Now a day's cultivation method of greenhouse is the growth of crops doesn't depend on nature and is controlled artificially. It consists of Lora modulation with agriculture parameters .There are some important parameters to be monitored and controlled inside the greenhouse. The objective is to provide organic farming and increase the yield. The result shows the remote control of carbon monoxide(CO), humidity, temperature, and light for the greenhouse. This system will help the farmers to avoid physical visit to the field and can increase the yield.

Keywords: IoT, LoRa, greenhouse, CO, humidity, temperature, and light.

1. INTRODUCTION

Developing plants has become an innovative test for agriculture parameters. A greenhouse is in the structure of house and is covered with a glass or plastic roof. In the past old days, they use to develop with only one type of plant. The greenhouse enables manipulation of crop environment[1]. The value of greenhouse crop cultivation is very higher than the open field cultivation.

The new era in computer communication is Internet of Things (IoT), gaining its importance because of wide variety of Application[2].Now in present world the agriculture parameters are controlled with a latest technology called LoRa using different sensors in greenhouse which is covered with transparent material. It is a framework which detects, measures and responds and it's a technology which recognizes greenhouse climate and the data is sent tocloud[2]. The system of greenhouse monitoring is designed based on measuring the parameters like temperature, humidity, carbon monoxide and light by sensors located at different places[3]. The sensors are even controlled and sends the data to farmer though SMS. The designed part consists of both hardware and software with LoRa technology.

A. Hardware Description:

To monitor greenhouse several sensors are used to control the environment. Parameters like temperature, humidity, carbon monoxide and light are for greenhouse[4]. This greenhouse monitoring system consists of sensors, PIC controller, LoRa module, LED and requires power supply unit.

B. Software Description:

This software is designed to read, control and monitor the parameters. In this software, we include several sensors measurements, LED blinking and updating the message to the farmer to monitor greenhouse[1]. Here we use PIC24FJ64GA306 for LoRa module controller which will display the parameters and updates will sent to the farmer to monitor and control greenhouse. Program is written in MPLAB X IED V4.05 and once the program is build successful in IDE the code will be burned with PIC KIT3.

C. Greenhouse:

The greenhouse will be in the shape of a house and is covered with a transparent roof or glass to maintain climate conditions and to control the parameters for healthy plant growth[4]. By this farmer can grow plants in any season maintaining ecological balance.

D. Long Range Technology(Lora):

LoRa is short for long range this module is designed by Semtech company. LoRa enables smart applications based on IoT like smart cities, smart agriculture, smart parking etc. It is a spread spectrum modulation technique derived from chirp spread spectrum and can create a smart planet. This is used to communicate long range links. LoRa modules are using Chirp spread spectrum modulation technique for sending information to long range with low power consumption.

2. METHODOLOGY

Now a days organic farming is most important for human so, the main aim is to give field data which is remotely monitored and controlled the greenhouse agriculture parameters like temperature, soil humidity, carbon monoxide and light using LoRa technology. By this technology a farmer can avoid physical visit and increase the yield[5]. To design this system, we need both hardware and software units. They are

1. Sensor unit
2. Processing unit
3. Communication device unit
4. Tools required

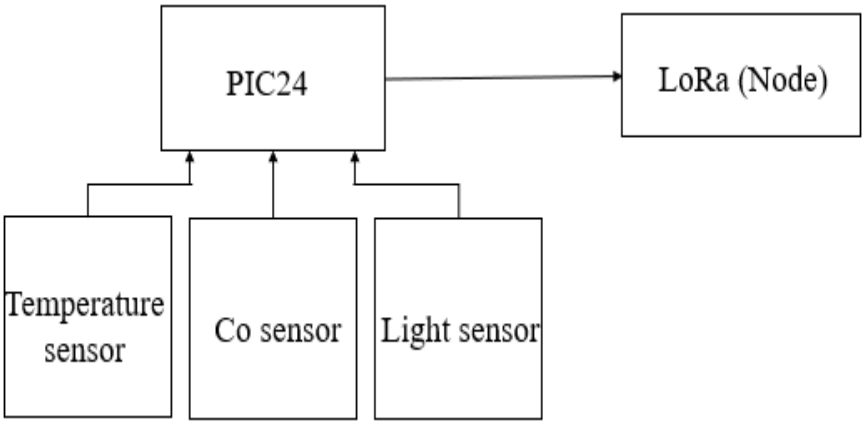

Fig.1: block diagram of transmitter

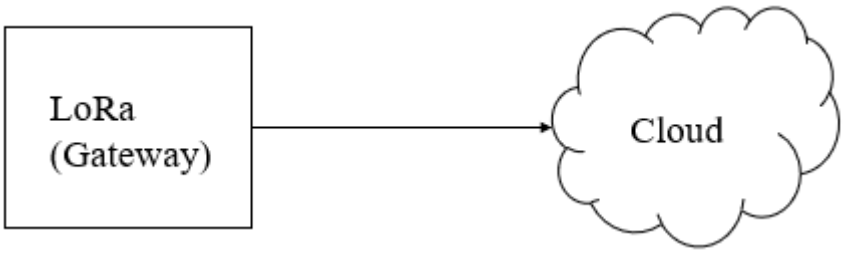

Fig.2: Block diagram of receiver

A. Sensor Unit:

From fig.1 the data is captured and sense the data. There are many definitions for sensor, but I like to define sensor as input device and gives an output with respect to specific physical quantity[4][6]. I use some sensors to monitor and control greenhouse as shown in the above figure, they are:

a. Temperature and Humidity sensor
b. Carbon monoxide sensor
c. Light sensor

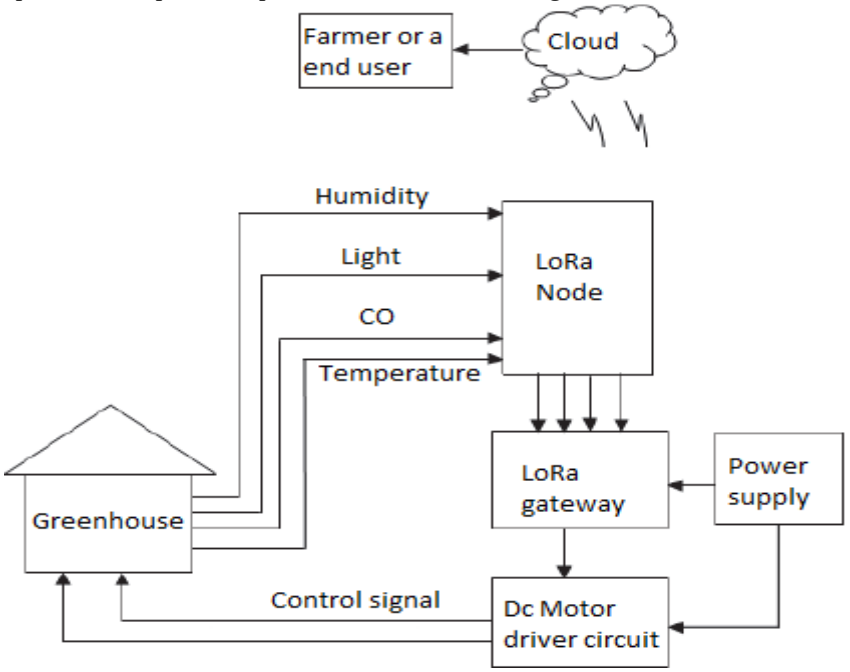

Fig.3:Block diagram

a. Temperature And Humidity Sensor:

Here, I use temperature and humidity sensor as SHT21 because it consumes low power and very easy to use. This sensor is utilized to sense humidity while temperature is measured by bandgap sensor[7]. Sensor I use is as shown in fig.4.

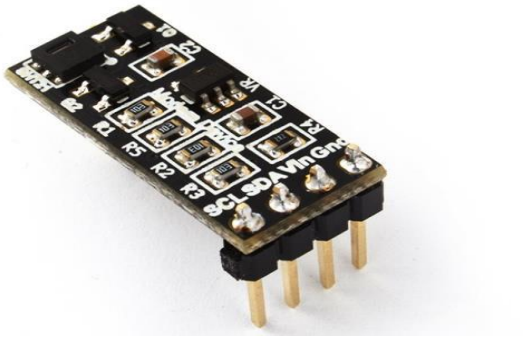

Fig.4: Sensor SHT21

In this SHT21 sensor a bidirectional direction will occur in single pin through I2C protocol. The relative humidity should be 0 to 100%RH range and temperature should be in -40^0 to $+125^0$C.

b. Carbon Monoxide Sensor:

For testing carbon monoxide in air, we use sensor called MQ7 because it has high sensitivity and fast response time. By this sensor we will get analog resistance as output. We use MQ7 sensor as shown in fig.5. This MQ7 detects the concentration of carbon monoxide in air.

Fig.5: Carbon monoxide sensor(MQ7)

c. Light Sensor:

Through this sensor light is detected and converts light energy to analog signal as output. Greenhouse plants require light to grow with out having damage and will not affect the organic plant[8]. Sensor will be as shown in the below fig.6.

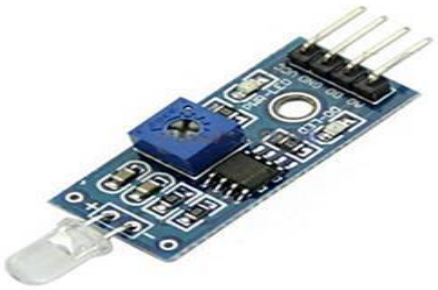

Fig.6: Light sensor

Thissensor senses the light in greenhouse agriculture parameters, and it is designed based on LM393.

B. Processing Unit:

The processing unit is used to get the information of data from sensor, processing and sending data to communication device. I use PIC24 controller for this system and the controller is used widely now a days. PIC stands for peripheral interface controller and here we use PIC24FJ64GA306, this is of PIC 24 family and PIC24F is 16-bit microcontroller[9]. This PIC24 microcontroller consumes low power.

Fig.7: PIC controller

As shown in fig.7 controller looks, and it is designed with the PCB which works with LoRa module. PIC24family has a communication key and control peripherals like UART, I2C, USB, SPI and timers but here in this system we use UART and I2C with PIC.

a. Inter Integrated Circuit(I2C) In PIC Controller:

The work which we do in this system is serial communication protocol[9]. The peripherals may be serial like ADC converters, display drivers etc. The sampling of bits by a clock signal is between master and slave.

b. Uart In Pic Controller:

UART stands for universal Asynchronous Receiver Transmitter which can communicate with personal computers and it is a full duplex asynchronous system. Full duplex means 8 or 9 bit data is transmitted through UxTX and UxRX pins.

C. *Communication Device(Lora Technology*):

LoRa stands for “Long Range”, it is a communication device and the physical layer which enables extremely long range communication. LoRa was formed to LPWAN[10]. We will know about LPWAN.LPWAN technology is especially designed for IoT applications and it sends data to long ranges with ultra-power consumption. By this LoRa technology a farmer can monitor their greenhouse from the place he is and can control the parameter for 900 meters to 10KM from the field. Here we use LM-130H1 LoRa module which is designed by Semtech.

Fig.8: LM-130H1

As I have shown in fig.8 is the module I use for the design of this system. I have selected this module because it has inbuilt Microcontroller to communicate with Lora device and the reason is it is low power consumption[4].

D. Tools Required:

We use two tools in this system they are:

a. MPLAB
b. PICKIT

a. MPLAB:

We use MPLAB X IDE in our system. The MPLAB X Integrated Development Environment (IDE) is a software program that runs on a PC to develop applications[11]. It

provides a single integrated "environment" to develop code for embedded microcontrollers. The MPLAB IDE provides the ability to create and edit source code and that's the reason I have selected this MPLAB for agricultural greenhouse parameters so that we can edit the source code when required. It can assemble, compile and link the source code.

b. PICKIT:

Here I use Microchip's PICKIT 3 for the system which allows programming and debugging of PIC and dsPIC Flash microcontrollers using the powerful graphical user interface of the MPLAB Integrated Development Environment (IDE)[12]. The USB port connection is a USB mini-B connector. Connect the PICKIT3 to the PC using the supplied USB cable.

c. Comparison On Various Technologies:

As we have studied regarding different technology as follows: In Bluetooth the module is frequency hopping spread spectrum and its range is 9meters. The data rate of Bluetooth is 1mbps and frequency is 2.4Ghz,as current consumption 60mA in transmitting mode.

The Zigbee has a modulation of direct sequence spread spectrum with the range of 30meters indoor and 100meters outdoor. Data rate is 250kbps,frequency range is2.4Ghz and current consumption ranges from25-35mA in Tx mode,3HA in standby mode.

As in WI-FI modulation is frequency hopping spread spectrum, direct sequence spread spectrum and range is 75 to 90 meters. It has a data rate of 11mbps, and frequency is 2.4Ghz,these Wi-Fi module current consumption 400mA in transmission mode and 20mA in standby mode.

In LoRa technology modulation is chrip spread spectrum(CSS) and the range is 1-10kms. In this technology the data rate is upto 200kbps. The frequency is 863-870Mhz and 902-928Mhz, as current consumption is as given Receiving is21mA, transmission mode is 125mA and sleepingmode is 5uA.

3. EXPERIMENTAL VIEW

Temperature and humidity sensor with pic micro controller the values are obtained. Data is transmitted from LoRa node to LoRa gateway and the programming is done with pic controller through MPLAB[12]. The pic kit data debugs and communicate with LoRa mode.

Fig.9: LoRa node

Node typically use Low Power and are battery powered. The LoRa sensors can transmit signals over distances from 1km to10km.

We have configured the above fig.9 board as LoRa node.

Fig.10: LoRa Gateway

The LoRa sensors transmit data to the LoRa gateways. The LoRa gateways connect to the internet via the standard IP protocol and transmit the data received from the LoRa embedded sensors to the Internet that is network, server or cloud. From fig.10 we can see that the board is configured as LoRa Gateway.

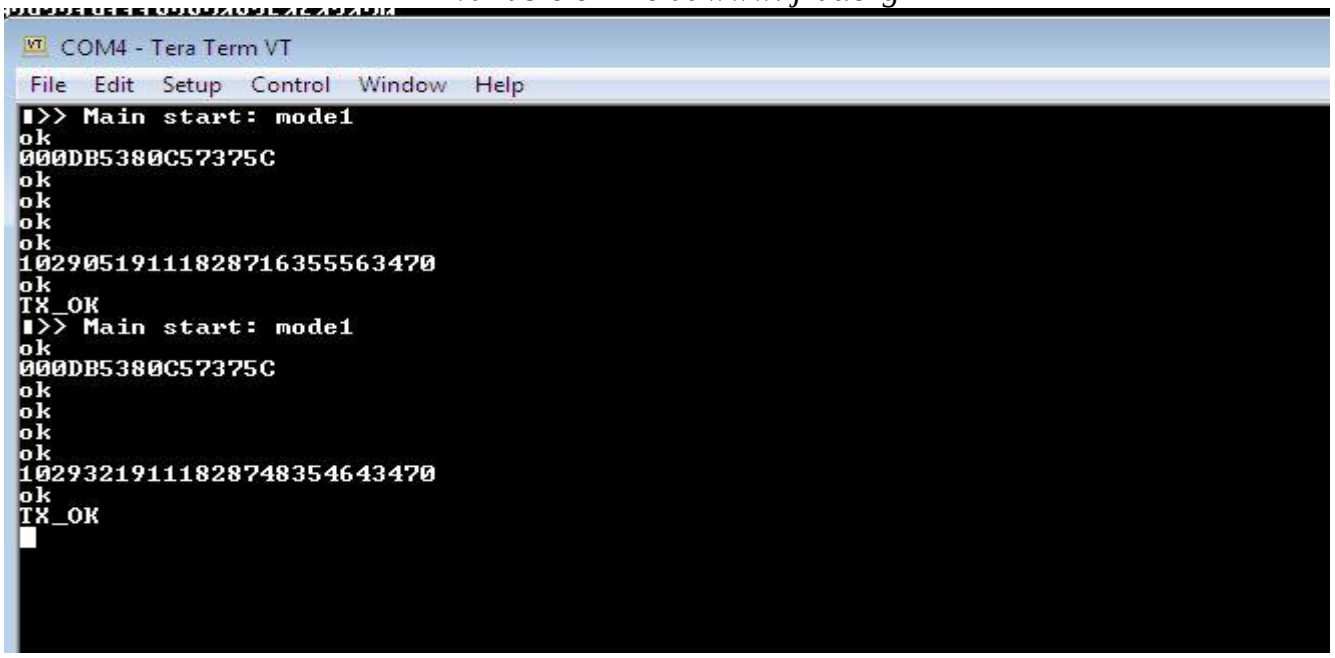

Fig.11: Data and acknowledgement at LoRa node

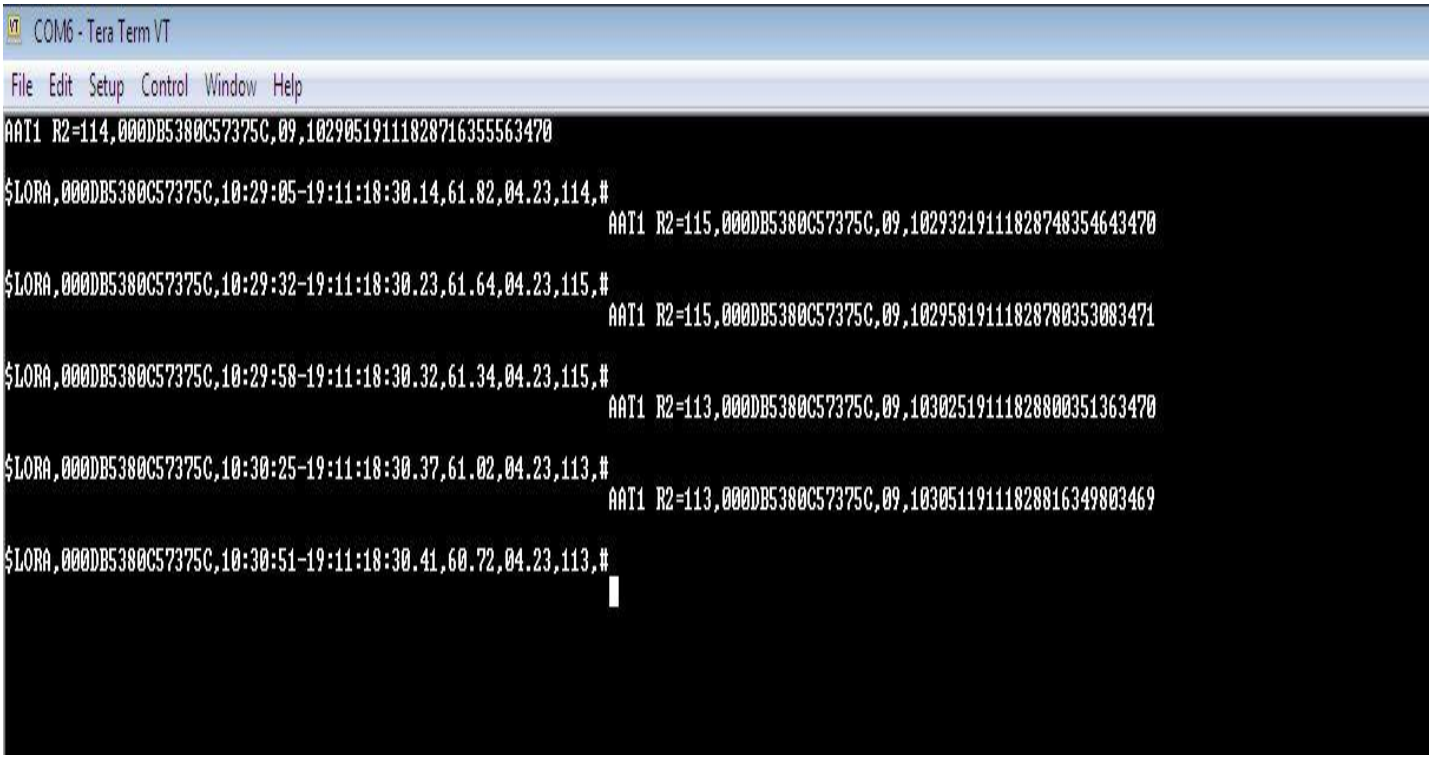

Fig.12: The data obtained at gateway

4. RESULTS

As we have monitored, and controlled greenhouse agriculture parameters based on LoRa technology. The parameters we have tested are temperature and humidity through the sht21 sensor. Through LoRa node the data is sent to LoRa gateway and updated to cloud. This system can be controlled with help DC motor with the help LoRa node. All these are stored in the cloud in the form of graph, values, chart etc., so that the farmer can easily improve the growth of plant.

5. CONCLUSION AND FUTURE SCOPE

The system is designed to remotelymonitor and controlling the greenhouse parameters such as CO, Humidity,temperature, and light, this information can be collected by thefarmers with the help of cloud account through LoRa technology.The system will help the farmers to avoid physical visit to the field and increase the yield.

The future work that can be done by other parameters of agriculture like soil moisture, fire detection, water capacity and so on.

REFERENCES

[1] K. Pallavi, J. D. Mallapur, and K. Y. Bendigeri, "Remote sensing and controlling of greenhouse agriculture parameters based on IoT," *2017 Int. Conf. Big Data, IoT Data Sci. BID 2017*, vol. 2018–Janua, pp. 44–48, 2018.

[2] G. N. Kodandaramaiah and V. Keerthi, "Cloud IoT Based Greenhouse Monitoring System," *Keerthi.v Int. J. Eng. Res. Appl.*, vol. 5, no. 10, pp. 35–41, 2015.

[3] S. Pallavi and J. D. Mallapur, "Remote Sensing of Greenhouse Parameters Based on," no. 10, pp. 34–36, 2017.

[4] A. Imam and D. Gaur, "Smart Greenhouse Monitoring using Internet of Things," *Int. J. Adv. Res. Electron. Commun. Eng.*, vol. 7, no. 5, pp. 519–523, 2018.

[5] Pavithra G, "Intelligent Monitoring Device for Agricultural Greenhouse Using IOT," vol. 9, no. 2, pp. 2–5, 2018.

[6] H. Chang, N. Zhou, X. Zhao, Q. Cao, M. Tan, and Y. Zhang, "A new agriculture monitoring system based on WSNs," *Int. Conf. Signal Process. Proceedings, ICSP*, vol. 2015–Janua, no. October, pp. 1755–1760, 2014.

[7] D. H. Park and J. W. Park, "Wireless sensor network-based greenhouse environment monitoring and automatic control system for dew condensation prevention," *Sensors*, vol. 11, no. 4, pp. 3640–3651, 2011.

[8] D. D. Chaudhary, S. P. Nayse, and L. M. Waghmare, "Application of Wireless Sensor Networks for Greenhouse Parameter Control in Precision Agriculture," *Int. J. Wirel. Mob. Networks*, vol. 3, no. 1, pp. 140–149, 2011.

[9] P. I. Madrap, "PIC Microcontroller Based Greenhouse Monitoring and Control System," *Int. J. Adv. Res. Electr. Electron. Instrum. Eng.*, vol. 5, no. 9, pp. 7701–7715, 2016.

[10] P. S. Asolkar, "Analyzing and Predicting the Green House Parameters of Crops," vol. 95, no. 15, pp. 28–39, 2014.

[11] K. Rangan and T. Vigneswaran, "An embedded systems approach to monitor green house," *Proc. Int. Conf. "Recent Adv. Sp. Technol. Serv. Clim. Chang. - 2010", RSTS CC-2010*, pp. 61–65, 2010.

[12] S. Muthupavithran, S. Akash, and P. Ranjithkumar, "Greenhouse Monitering Using Internet of Things," *Int. J. Innov. Res. Comput. Sci. Eng. www.ioirp.com*, no. 2, pp. 2394–6364, 2016.

[13] https://www.semtech.com/products/wireless-rf/lora-transceivers

[14] https://www.microchip.com/mplab

[15] https://www.sunrom.com