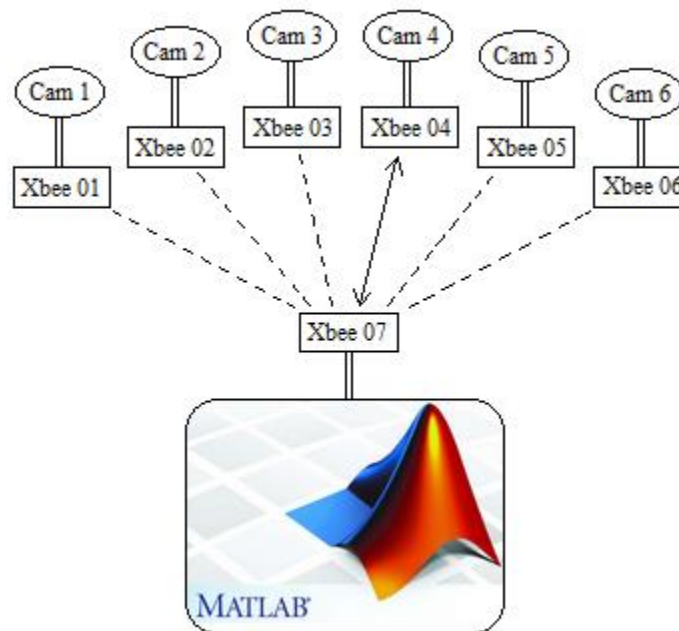


Multiple Serial-camera Imaging system using dynamic point-to-point Xbee link

A Guide to image acquisition from multiple serial-cameras connected through wireless Xbee links using Matlab



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I. Introduction

This document illustrates the technique for image acquisition from multiple serial-cameras (each aided with an Xbee module) using Matlab running on a Computer (aided with a Xbee module). Through Matlab any one camera can be selected at a time using the unique address assigned to the corresponding Xbee. Once, the connection with one camera is established, the routine to capture image from a serial-camera module using Matlab follows.

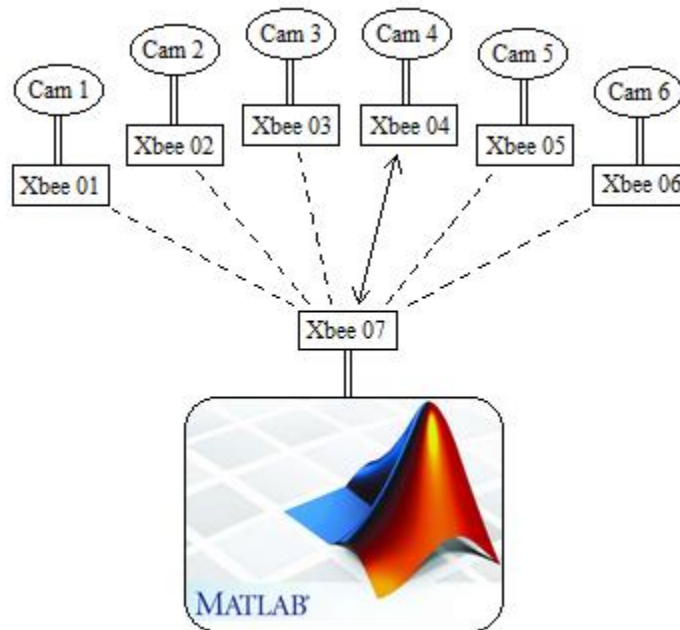


Figure 1.1: Example of the multiple serial-camera imaging system

The Figure 1.1 shows an example of such a multiple serial-camera imaging system in which the Xbee 07 has the capability to establish link with other Xbees, while it has established a link with Xbee 04 so that the Matlab can communicate with the Cam 4.

II. Xbee Addressing

The RF data packets transmitter by Xbee contains a Source Address and a Destination Address field in its header. The Xbee module follows the 802.15.4 specification and supports both short 16-bit addresses and long 64-bit addresses. A unique 64-bit source address is assigned to each Xbee right from factory which cannot be modified. On the other hand short addressing must be configured manually.

Here, we have used 16 bit addressing or short addresses. The DL(Destination Address Low) parameter specifies the address of the Xbee to which the data will be transmitted and the MY parameter specifies the source address from which the data will be transmitted. Thus depending on the network configuration these parameters need to be changed.

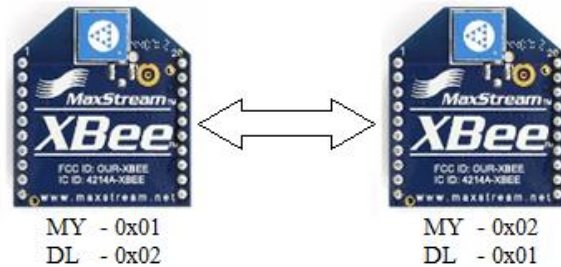


Figure 2.1: Establishing link between two Xbee modules using short addresses

III. Configuring Xbee Address

The short addresses assigned to Xbee modules – MY and DL can be manually changed using the X-CTU software using the following steps-

1. Open X-CTU software after connecting Xbee module to a computer using any adapter board- USB based or RS-232 based.
2. Select the serial COM port to which the Xbee is attached.
3. Go to Modem configuration
4. Under ‘Modem Parameter and Firmware’ click on ‘Read’ to read the Xbee module parameters.
5. Change the DL and MY parameters to desired values.
6. Under ‘Modem Parameter and Firmware’ click on ‘Write’ to write the Xbee module parameters.

The short addresses can also be assigned to the Xbee module by issuing the following commands from the terminal of the X-CTU software from Digi.

Sample Configuration for changing the DL of the Xbee module

Send AT Command	System Response
+++	OK<CR>(Enter into Command Mode)
ATDL<Enter>	{ Current value }<CR>(Red destination address)
ATDL01<Enter>	OK<CR>(Modify Destination Address Low)
ATWR<Enter>	OK<CR>(Write to non-volatile memory)
ATCN<Enter>	OK<CR>(Exit Command Mode)

Sample Configuration for changing the MY of the Xbee module

Send AT Command	System Response
+++	OK<CR>(Enter into Command Mode)
ATMY<Enter>	{ Current value}<CR>(Read Source Address)
ATMY02<Enter>	OK<CR>(Modify Source Address Low)
ATWR<Enter>	OK<CR>(Write to non-volatile memory)
ATCN<Enter>	OK<CR>(Exit Command Mode)

IV. Description of the multiple-camera imaging system setup

The setup has of a group of end entities and a central entity. Again each of the end entities consist of a *serial-camera module*, an *RS-232 based Xbee adapter*, and a *5-9V DC power supply*. On the other hand the central entity consists of a *computer* connected to a *USB based Xbee adapter*. All the entities and their configuration will be discussed in this section.

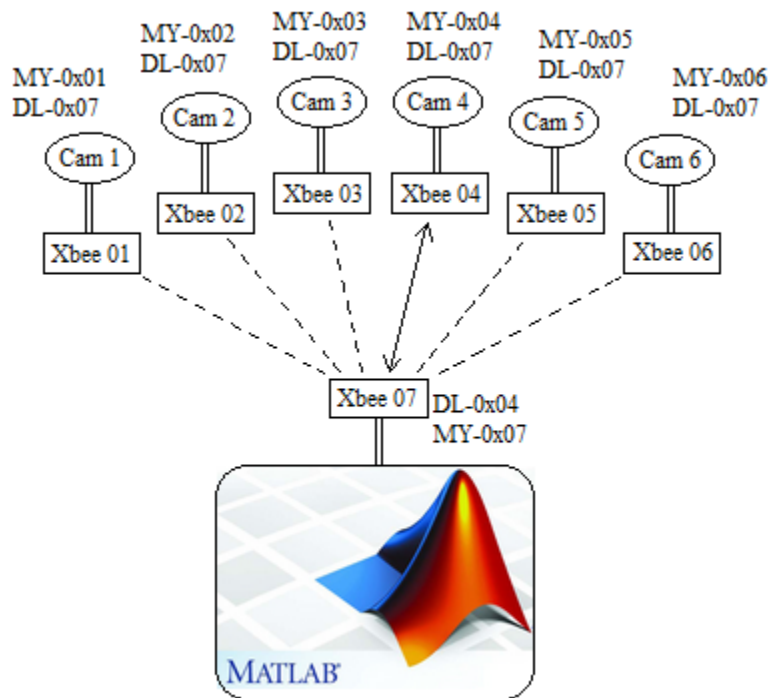


Figure 4.1: The multiple camera imaging setup

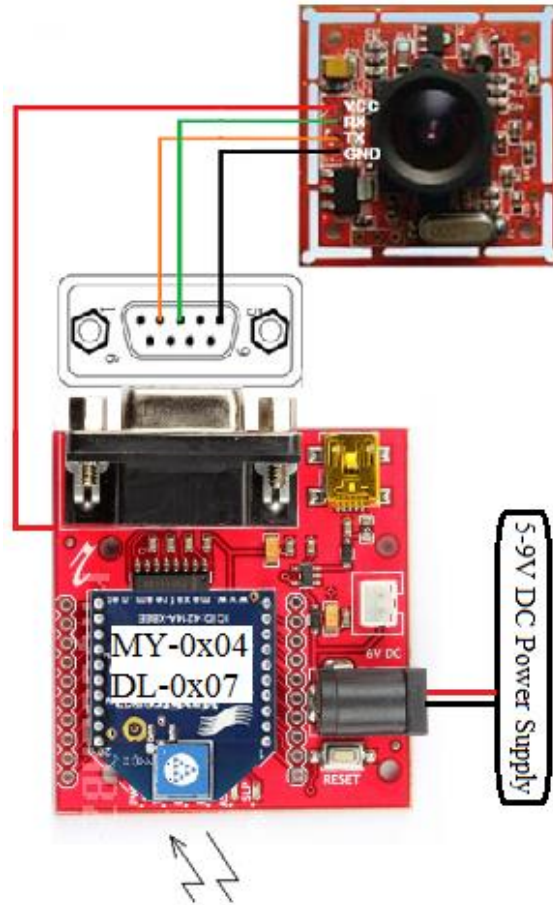


Figure 4.2: The end entity

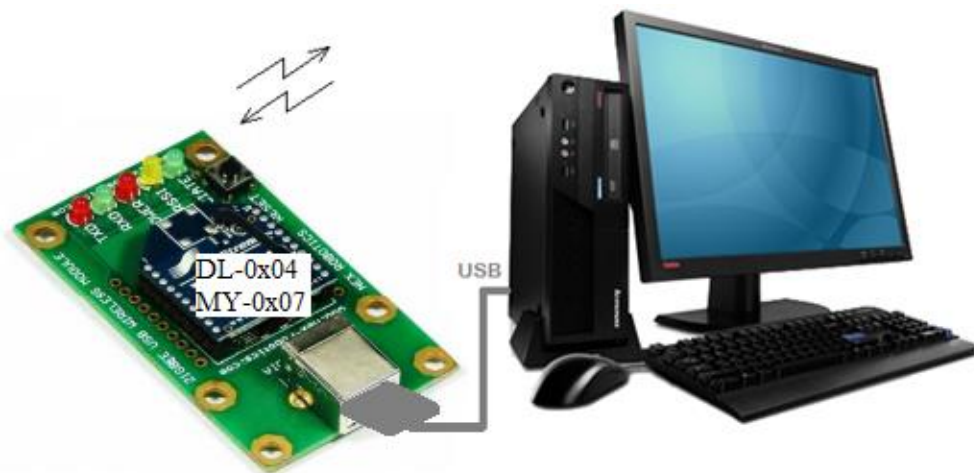


Figure 4.3: The central entity

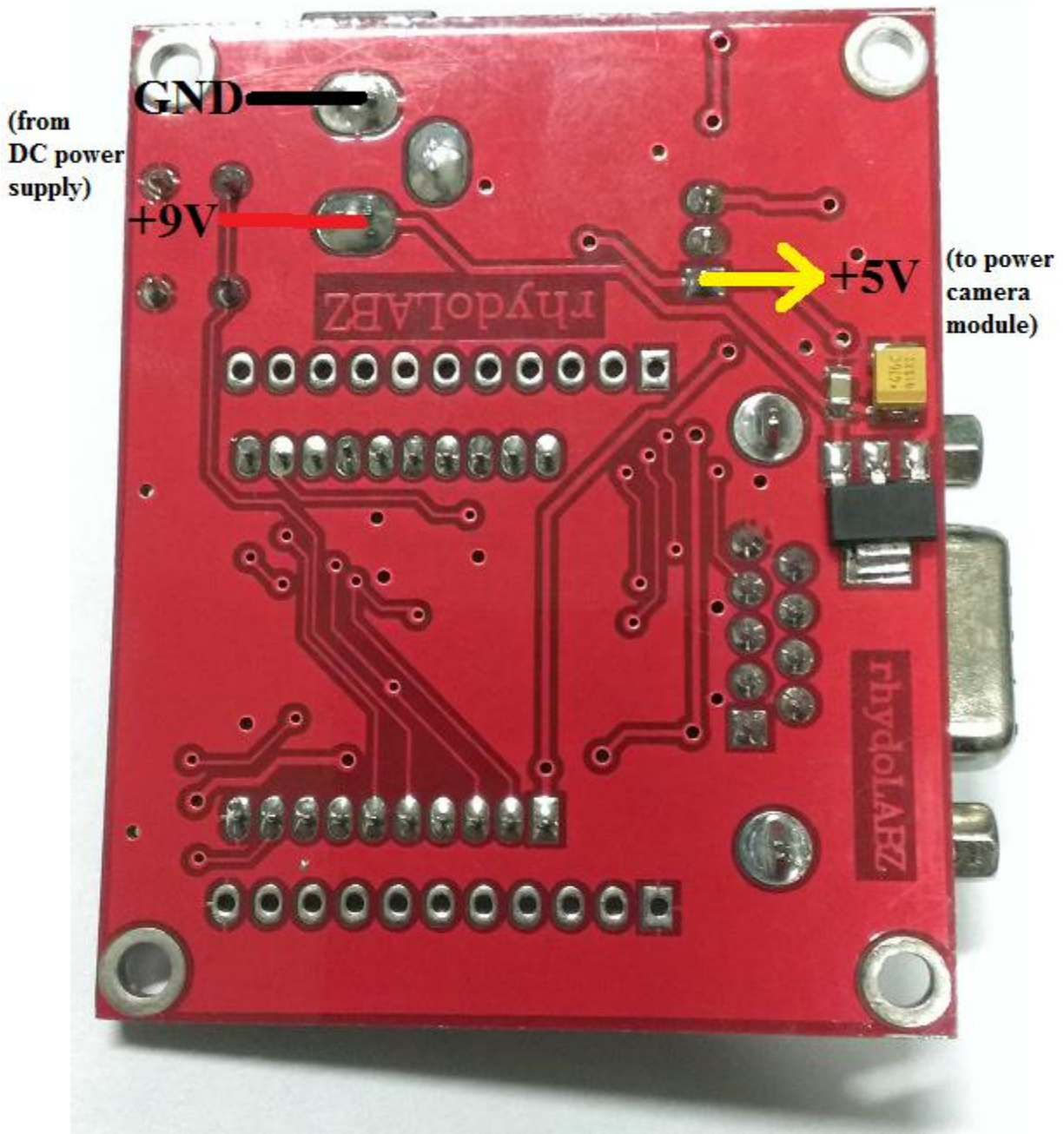


Figure 4.4: Supplying power to the Xbee adapter and drawing 5V for powering the serial-camera module

The Xbee adapter board can be powered up using 5-9V DC power supply by using wires and 5V DC can be drawn from the output of the 5V onboard voltage regulator IC as shown in the Figure 4.4

V. Image Acquisition from multiple cameras using Matlab Software

The method for image acquisition from multiple cameras using the Matlab software is similar to the process of the image acquisition from a single serial-camera module connected via Xbee link. The only exception is that at the beginning a point-to-point link between the end Xbee module and the central Xbee module has to be established using the user input. The point-to-point Xbee link is not fixed and it changes with time depending on user input. To establish the point-to-point link the Xbee has to be operated in Command mode, in which the serial data is treated as a command by the Xbee module. The procedure will be discussed in steps which would help in understanding the structure of the Matlab code.

Step 1: Serial Object for the Xbee module connected to the computer

Step 2: Set up a loop to enter command mode and change the DL from 0x01 through 0x06 to do the following in all iterations -

- a. Send *SYNC* Command
- b. Send *Initial* Command
- c. Send *Set Package Size* Command
- d. Send *Snapshot Compressed Image* Command

This block of commands can also be put in a separate Matlab function and can be called only once in the beginning of the main program as a part of, initial one time configuration for the camera modules and hence need not be done every time we need to take a snapshot.

Step 3: Start a while 1 loop and ask for user input. If the input is outside 1-6 go to Step10

Step 4: Enter the command mode of operation of Xbee module. Modify and write the desired value of the parameter and exit from command mode. After the execution of this step a point-to-point Xbee link is established.

Step 5: Send the *Capture image* command and read the commands to calculate the size of the number of packets to be received.

Step 6: Read the packets

Step 7: Extract compressed image data

Step 8: Display the JPEG image.

Step 9: End while loop and go back to Step 3.

Step 10: Close, delete and clear serial object.