Cellular Network Based on a PIC12C509

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INTRODUCTION

This application note describes a method for designing a cellular network with lower count components and at a lower price. The cellular network allows connections between geographically dispersed objects (stationary or mobile) which have an equal priority. The function of each cell is very simple, but when worked together, the network has all of the necessary functions to realize the connections, like a search, read, write, identify, navigate, etc.

The application of this cellular network may be increase if the radio transceiver is changed with an ultrasonic transceiver. It may be applied in submarine robot control, diver navigation, etc.

PRINCIPLE OF OPERATIONS

The schematic of the cell is shown on Figure 2.

The design requires minimum components. The XTALL oscillator is within a 0.1% tolerance. The kind of transceiver depends on the designer's preferences. In this case, it is uses a transceiver based on Motorola's chipset MRFIC200X, with a carrier frequency of 900 MHz and a range of about 1 mile. The necessary working signals are:

RxD	–	Received data from transceiver
TxD	–	Transmitted data to transceiver
S/R	–	Send/receive – controls the direction of data transfers
CD	–	Carrier detect – inform the PICmicro™ that is detected a transmission

Each cell may be connected with an object, or with a minimum of 1 and amaximum of 4 other cells – this is a N cell, a S cell, a O cell, and the W cell (Figure 2) Each object may be connected with a minimum of 1 and a maximum of 4 cells. The address of the cell (e.g., it's coordinate) is the number of the column (C) in the network and the number of the row (R). The number of the columns and rows depends of the application and, theoretically, has no limits. The address is valid in four quadrants of the network. In this case, the first quadrant address is +C, +R; the second quadrant, –C, +R; the third quadrant, –C, -R; the fourth quadrant, +C, -R. The address of the first cell is C0R0. This scheme of addresses allows for the inserion and deletion of cells, if necessary, without to making any changes in the software of the cells.

If the number of the columns or rows is increased, it may create a long distance channel to connect with remote objects or another remote cellular network.

FUNCTION OF CELLULAR NETWORK

Identify

The IDENITFY function allows each cell to identify their own address and the address of their neighboring cells. When the Cellular Network is installed, only five cells are with factory-setting addresses: C0R0, C1R0, C0R1, C-1R0, C0R-1. The function is always initiated always with cell C0R0. The 'zero' cell transmits the command identify with address C0R0. The next four cells transmit this command with their own address in the four time slots with counter-clockwise sequence: C, R, -C, -R. The next cells make a logical table depending on the received address, and fix own address and address of neighboring cells, and also transmit the command with own address. If the next cell not present it is mark in the table with 'N'. In this way the command identify is diffuse like a wave on the all Cellular Network.

Navigate

The NAVIGATE function locates the coordinates of all the objects in the network and is initiated by any object which is the master in this moment. The object transmits the command to the nearest cell, and the command is translated like a wave on the network. The priority of answer is according of the range of the address of nearest cell, which is in this moment an "interface" cell. The criteria is: if the address is between the "remote" object and the "master" object – this is the high priority. After this address of the object is written in the device table, the "master" object reads the next and so forth.

Write

The WRITE function transfers the data between two or more objects. The object which is the “master” in this moment translates the command to the nearest cell. The command field has an area for the source address (this is address of nearest cell) and the destination address (address of the cell nearest the object, reception for message). Each cell works with a simple algorithm:

- If (RD-RS)/(CD-CS) < 1
  the message is addressed to the next column
- If (RD-RS)/(CD-CS) > 1
  the message is addressed to the next row
- If (RD-RS)/(CD-CS) = 1
  the message is addressed to the next column if exist, else to the next row.

Note: RD = Row to Destination,
RS = Row to Source,
CD = Column to Destination
CS = Column to Source

In this manner, the cells are independently fixed to the path of the transmission.

Read

The READ function transfers the data back between the ‘initiate’ object and the ‘remote’ object. This command is execute in two stages. The first transfers a WRITE function with an including READ command. In the second is, the WRITE command from destination to source. The navigation is similar as a command write.

FIGURE 1: BLOCK DIAGRAM

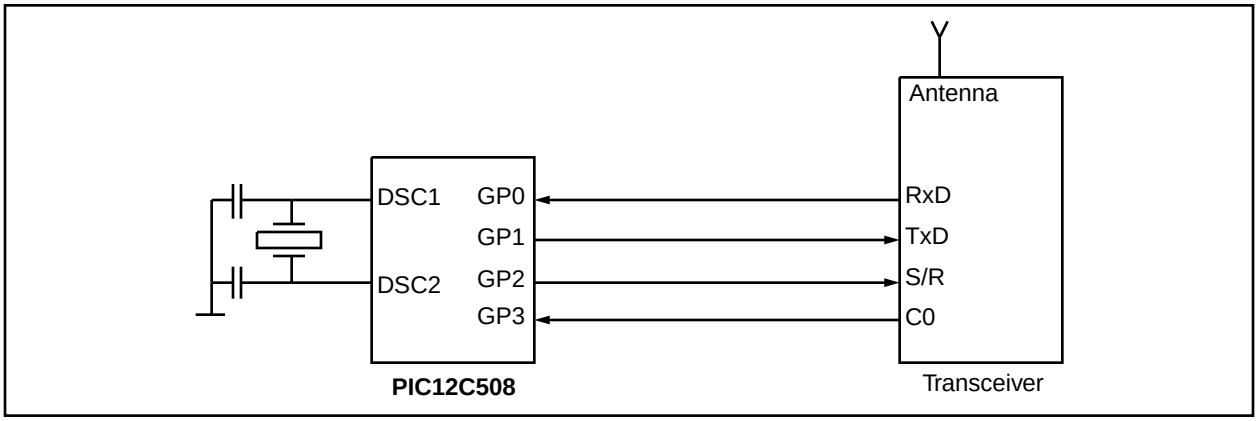
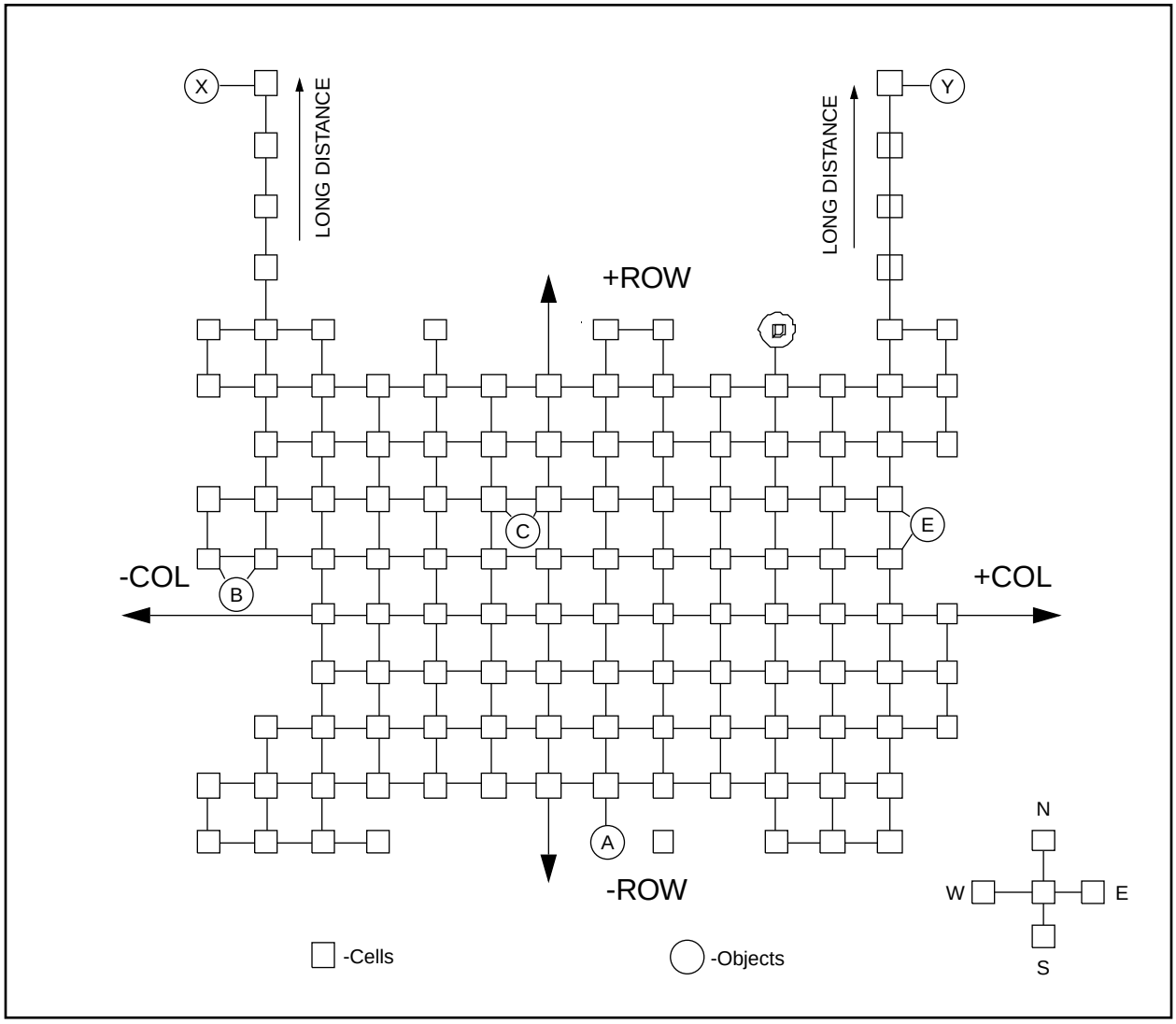


FIGURE 2:


X
LONG DISTANCE
Y
LONG DISTANCE
+ROW
D
C
E
-COL
B
+COL
A
-ROW
N
W
E
S
-Cells
-Objects

FLOWCHART