CONTROLLING MOBILE ROBOT VIA PERSONAL DIGITAL ASSISTANCE (PDA)

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Abstract: In this project, we present controlling of a Robot using Bluetooth via Personal Digital Assistance (PDA). This project applied concept of providing the Personal Area Network (PAN) for PIC16877A microcontroller Robot Controller Board (RCB). The PDA runs with Mobile Window 6 and has capableness to communicate thru Bluetooth. Both side the PDA and RCB used Bluetooth communication to execute the task. The PDA as Host and Bluetooth stack at RCB architecture is implanted on single microcontroller chip. The PAN will make this mobile robot able to perform the task by the given command thru PDA.

Key Words: PDA /Bluetooth /PAN/Mobile robot/wireless communication.

1. INTRODUCTION

A robot is a mechanical or virtual, artificial agent. It is usually an electromechanical system, which, by its appearance or movements, conveys a sense that it has intent or agency of its own [1]. This robot is combination of electronic components (sensor, transducer, micro controller and et cetera), power supply (batteries, solar cell, fuel and et cetera) and mechanical part (motor, tyre and gear). Basically robot can be categories in three groups; Tele Robot, Autonomous Robot and Semi Autonomous Robot. The word robot can refer to both physical and virtual software agents, but the latter are usually referred to as bots to differentiate. Robots can be placed into roughly two categories based on the type of job they do: Jobs which a robot can do better than a human [1].

In this project we had develop the mobile robot that can be controlled via PDA by using PAN between the Host (PDA) and the mobile robot. The Bluetooth command transmitted from PDA will send the data to the microcontroller at mobile robot as command to move the robot in any direction. This make the communication can be made wireless. This robot also equipped with mobile IP Camera which also can be view from PDA using Internet thru web base. This mean the user can view the real time image (video) while steering the robot movement.

2. BLUETOOTH HISTORY

The Bluetooth is named by the Denmark’s first king Harald Bluetooth (A.D 940 to 985). History suggests that Harald's aggressive diplomatic policies led to the unification of previously warring tribes of Denmark, Norway and Sweden. Like Harald, Bluetooth technology is about communication - allowing different electronic devices to communicate each other wirelessly. In 1994, a team of scientist (Sven Mattisson and Jaap Haartsen) investigates other wirelessly. In 1994, a team of scientist (Sven Mattisson and Jaap Haartsen) investigates the possibility developing the wireless connection between phone and ear-piece. This research continues by Ericsson where he realized not only the myriad possibilities offered by such a technology but also the necessity for a standard without associated licensing fees. One of the greatest challenges in creating and implementing such a technology would be interoperability between different vendors. Bluetooth namesake is that of a Viking King who united many of the Scandinavian countries peacefully. So his name seems very appropriate for the original idea to link the two worlds of computers and phones. The Bluetooth Special Interest Group (SIG) was founded in 1998 composed of industry heavyweights as IBM, Ericsson, Nokia, Intel and Toshiba. Officially announced in May of the same year, Bluetooth has since garnered much interest, acclaim and derision in equal measure.

3. WIRELESS TECHNOLOGY

Tele-robot is used widely in many application this Tele-robot generally controlled by wireless connectivity to give the robot free space to move without constraint because of cabling (wired) between controller and the robot platform. Therefore in this research the wireless communication is selected to be used for robotic control communication. Generally there are three main type of wireless network, such as:
A **scatternet** is a number of interconnected piconets that supports communication between more than 8 devices. Scatternets can be formed when a member of one piconet (either the master or one of the slaves) elects to participate as a slave in a second, separate piconet. The device participating in both piconets can relay data between members of both ad-hoc networks. However, the basic Bluetooth protocol does not support this relaying - the host software of each device would need to manage it. Using this approach, it is possible to join together numerous piconets into a large scatternet, and to expand the physical size of the network beyond Bluetooth's limited range.

**Table 1. Class of Bluetooth**

<table>
<thead>
<tr>
<th>Class</th>
<th>Maximum Permitted Power (mW)</th>
<th>Range (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>100</td>
<td>-100 meters</td>
</tr>
<tr>
<td>Class 2</td>
<td>2.5</td>
<td>-10 meters</td>
</tr>
<tr>
<td>Class 3</td>
<td>1</td>
<td>-1 meters</td>
</tr>
</tbody>
</table>

In most cases the effective range of class 2 devices is extended if they connect to a class 1 transceiver, compared to a pure class 2 network. This is accomplished by the higher sensitivity and transmission power of Class 1 devices.

**Table 2. Data Rate Bluetooth**

<table>
<thead>
<tr>
<th>Version</th>
<th>Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.2</td>
<td>1 Mbit/s</td>
</tr>
<tr>
<td>Version 2.0 + EDR</td>
<td>3 Mbit/s</td>
</tr>
<tr>
<td>Version 3.0 + HS</td>
<td>24 Mbit/s</td>
</tr>
</tbody>
</table>

While the Bluetooth Core Specification does mandate minimums for range, the range of the technology is application specific and is not limited. Manufacturers may tune their implementations to the range needed to support individual use cases.
5. ARCHITECTURE

The architecture for controlling mobile Robot using Bluetooth via Personal Digital Assistance (PDA) is shown in Figure 1. The module divided into two groups which PDA consist of PuTTY open source SSH client, phone Bluetooth and Image Client for IP camera. While in Mobile robot module consists of Bluetooth transceiver stack (SENA Parani SD1000), RCB, motor driver and Image server (IP camera).

![PuTTY SSH](image1)

**A. PuTTY**

PuTTY is a free SSH client developed by Simon Tatham and others [5]. This Secure Shell or SSH is a network protocol that allows data to be exchanged using a secure channel between two networked devices. In this project it is use to make connection between PDA communication Port to the serial port of Robot Controller Board (RCB). The serial data from PDA will be sending wirelessly via PAN between PDA and RCB to make mobile robot can perform the command send by the user via PDA. PuTTY window (Figure 3) will run in Mobile Window and to make the communication establish the user need to activate the Bluetooth connection and tick the Radio Button to turn on the Bluetooth, this will enable the Bluetooth and ready to send or receive the data. At robot controller (RCB) the Bluetooth stack also need to be turn ON (Figure 2).

![PuTTY Stack](image2)

**B. Interfacing**

The Robot Control Board features the PIC16F877A, 256 bytes of EEPROM data memory microcontroller and supply from 12VDC sealed lead acid rechargeable battery for power source to drive the motor robot as well as the components necessary to interface with a PC, DC motors [6]. The interfacing to microcontroller PIC16F877A is done thru serial port. The PIC is programmed is written in C and compiled with the MPLAB IDE Ver. 8.3, that can be downloaded at www.microchip.com/downloads. The programming set the serial communication setting to (19200, 8, n, 1). For motor controlling port B has been selected as the output (Pin 33 to 40). The movement of the motor summarized in Table 3 below.

<table>
<thead>
<tr>
<th>Motor</th>
<th>RB4</th>
<th>RB5</th>
<th>RB6</th>
<th>RB7</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWD</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>REV</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>LEFT</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>RIGHT</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The following examples provide code to move the motor forward:

```c
    case '1':
        RB4=0; RB5=1; // Right Motor ON Forward
        RB6=1; RB7=0;  // Left Motor ON Forward
```

The case ‘1’ is data that will send by PDA to the microcontroller in RCB of mobile robot. When the microcontroller receives data ‘1’ the PIC will activate port B pin (38 and 36) to become high (5 volt). This output will trigger the motor driver to drive the motor forward.
become forward. These conditions also happen for Reverse, Left and right. At PDA display (Figure 4) will appear the string to show the state of motor drive.

Figure 4: shows the connection Bluetooth UD100 and SD1000, interface with PIC 16F877A

C. Robot Assembling

For assembling the robot it is important to make sure all part of the robot component (including software) operate in good condition. This to make sure nothing will happen after assembling process completed, if not to troubleshoot will become a nightmare because all part need to be check and test again to find the fault and this is not better way to the assembling process. In the software part, the User controller as mention in part 5.1 using PuTTY open source SSH client for PDA. This SSH link to PIC robot’s controller board thru serial port (RS232) via Bluetooth communication (PAN). Instead of interfacing the hardware (electronic components) and software it is important to make sure the platform of robot perform in great functioning. This is the reason the selection of framework, wheel and casing of the robot need to be done accordingly. The structure or framework itself represents the outline of the entire this construction of functioning robot. Figure 5 depicts the methodology apply for this project.

Figure 5: Design methodology of mobile robot.

6. Result

In part 5 (Architecture) it is shown that the Bluetooth communication tested using PuTTY SHH, this program act like Hyperterminal in computer base. Since the communication can be enable and data can be received (Figure 4), thus for giving this mobile robot more pleasant to be controled by user, this Graphic User Interface (GUI) was developed using Mobile Window. Figure 6 shows GUI display from PDA screenshot, this panel (left) contain three sections such as connection comm. Port, controller button and Rx/Tx data. To make the mobile robot move, first the comm. Port need to be establish, before to do this connection the PDA Bluetooth is in enable state. After this Bluetooth is enable, comm. Port selection is made by selected from list (top left figure 6.a), beside this list have two button “Connect” and “Disconnect” these two button will establish or remove the connection of Bluetooth. If the connection is successful Rx Data row will display received data from PIC mobile robot. The user can control the robot by pressing the button for forward, reverse, left and right accordingly. Figure 6.b shows information on this software.

7. Conclusion

This project had been carried out successfully, to prove the PDA, smart phone and computer can be hookup and establish connection using Bluetooth communication. In this project the Bluetooth had been used as wireless communication for controlling any device. The application of this project can be used to control telerobot in many fields such for safety and security purpose. This application also can be used to help older and disable people. For future development this design can be controlled via Ethernet to give user wider controlling scope.
8. Acknowledgment
I would like to thank the Universiti Teknikal Malaysia Malacca for approving my project to be carried out and also I would like to thankfulness and appreciation allowing me to present this paper.

9. References