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The Symbian Robot

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Abstract - As mobile phone handsets attain increasing capabilities, there are many more opportunities for novel applications development. While it is important to respect these resource constraints, some of the unique features of mobile phones also want to highlight, such as high quality audio, constant connectivity and comfortable form factor for use as device to interact with the physical world.

In this project, there is exploration of the opportunities available with the usage of Symbian OS coupled with Bluetooth technology in developing an environment for current mobile phones and demonstrate applications and simultaneously exploiting the unique features of these commercially available devices. Applications for mobile phones have been limited to standard telephony or messaging services, PDA activities (calendar and contact management) and games. In this paper, the goal is to demonstrate that viewing a handset as a generic computing platform with some unique capabilities opens up the possibility for a variety of interesting applications. The main aim of the paper is to design and develop a symbian OS coupled with Bluetooth technology based wireless remote control to control motions of robot in the real time applications with four degrees of freedom.

In this paper, there is a development of program which uses the symbian OS, which reads the data from the MEMS sensor present in the cell phone. This data is then compared to the stored data and then the user will get to know the way the cell phone is being tilted, This data is sent to the robot using the blue tooth technology that is present in the cell phone. At the other end the Blue tooth in the robot will read the data and will send the data to the micro controller, which will then accordingly drive the robot in the direction as required by the user.

Keywords - Motioncontrol, CPLD, MEMSAccelerometer, Bluetooth, Symbian OS.

I. INTRODUCTION

Mobile phones are the most pervasive portable computers currently available having the capabilities to alter and manipulate our perceptions. They contain various sensors, such as accelerometers and microphones, as well as actuators in the form of vibro-tactile feedback. Visual feedback may be provided through mobile screens or video eye wear. To ensure a fast adoption rate of gesture recognition as an Ubiquitous input mechanism, technologies already available in mobile phones should be utilized. Features like accelerometer sensing and vibro-tactile feedback are readily available in high-end mobile phones, and this should filter through to most mobile phones in the future. Gesture recognition allows users to perceive their mobile phone as an input mechanism. Dynamic input systems in the form of gesture recognition are proving popular with users, with Nintendo's will be in buttons, but also by body movement. This application helps in controlling the wheel chair or the robot or a toy car with less physical efforts thus improving overall well being and quality of life. Robotics is concerned with the study of machines that can displace human beings in

implementing processes, in physical activity and decision making. Smartphone or podcasts are considered these days a very important device in our life. The addictiveness has been to such an extent that normal day-to-day activities cannot happen without mobiles. Mobiles are developed every day, every day there is a new model that include new features catering to increased demands with changing lifestyle.

II. SYMBIAN OS TECHNOLOGY

Symbian OS is an operating system that is designed especially for data enabled mobile phones. Symbian OS designed to be flexible and it can be used on devices with different user interfaces. [3] Symbian OS is the advanced open operating system licensed by the world's leading manufacturers. Symbian OS combines the power of an integrated applications environment with mobile telephony, bringing advanced data service to mobile users. Compact enough to fit in the memory of a mobile phone, and it was planned from the beginning to be a full operating system in terms of functionality. One manufacturer. Symbian OS combines the power of an integrated applications environment with mobile

telephony, bringing advanced data service to mobile users. Compact enough to fit in the memory of a mobile phone, and it was planned from the beginning to be a full operating system in terms of functionality. It includes a robust multi-tasking kernel, integrated telephony support, communications protocols, data management, advanced graphics support, the lower levels of the GUI framework, and application engines. Compact enough to fit in the memory of a mobile phone, and it was planned from the beginning to be a full operating system in terms of functionality.

It includes a robust multi-tasking kernel, integrated telephony support, communications protocols, data management, advanced graphics support, the lower levels of the GUI framework, and application engines. [4] Symbian OS enables mobile phones to be a platform for deployment of applications and services developed in a wide range of languages and content formats. With a flexible and modular implementation, Symbian OS provides a core set of applications programming interfaces and technologies that are shared by all Symbian OS phones. It is based on micro kernel architecture and implements full multi-tasking and threading. System services such as telephony, networking middleware and application engines all run in their own processes. The operating system has been designed from the ground up with mobile devices in mind, using advanced object oriented techniques, leading to flexible component based architecture. [5]

III. BLUETOOTH

Bluetooth is a wireless technology in a short-range communications system that aims to replace cables connecting portable. It has many features like robustness, low power, and low cost. [2]. This technology was designed firstly to support simple wireless networking devices, including cell phones, wireless headset, wireless. mice, and PDA's.. Bluetooth devices generally communicate at less than 1 Mbps. [4] Bluetooth requires a low cost transceiver chip to be included in devices. Since Bluetooth operates in the unlicensed ISM band that is also used by other devices such as 802.11 net-works, baby monitors, garage door openers, microwave ovens etc, there is possibility of interference. Bluetooth uses Frequency Hop Spread Spectrum (FHSS) to avoid any interference. A Bluetooth channel is divided into time slots each 625 micro second in length. The devices hop through these timeslots making 1600 hops per second. This trades bandwidth efficiency for reliability, integrity and security. In this project BT-class 2 module version 1.03 is used. The goal of this device is provide wireless communication between robot and cell phone. When the Bluetooth in the cell phone is turned on it will automatically interfaces with the robot.

IV. SYSTEM DESIGN

Fig. 1 : system design

This system design can be divided into two parts. one part is hardware components connection to build robot; the other part is interfacing cell phone with robot using Bluetooth. from the above figure Signal conditioning unit is built in the microcontroller. The input signals to this unit are from Bluetooth device. The microcontroller used is pic –microcontroller of version PIC16F87X. It is 28/40-pin 8-bit low power, high speed CMOS FLASH/EEPROM Microcontrollers. This will receive the data from the Bluetooth through serial communication using USART and it will process the data such that CPLD(complex programmable logical design) chip can under stood. Hence the data is sent to the CPLD chip through parallel communication. Here the microcontroller IC will be programmed from the PC using RS232. CPLD (Complex programmable logic device) is a PLD that has Non-volatile configuration memory. Unlike many FPGAs, an external configuration ROM isn't required, and the CPLD can function immediately on system start-up.CPLD-XC952 9500 family version is used. In this project, it is used in order to control and for maintaining the direction of the motor used in this robot. Driver used is ULN2003 series driver. It is16 pin DIP IC having high-voltage, high current Darlington drivers comprised of seven NPN Darlington pairs. The high output current is 500mA MAX and high sustaining output voltage is 50V MIN. In this project it used in order to drive the motor according to the signals/instructions given by the CPLD chip. Motor used is brushed DC electric motor is used which includes advantages like low initial cost, high reliability, and simple control of motor speed. The rotational speed of a DC motor is proportional to the voltage applied to it. Hence this speed and direction of movement of brushes in the motor is controlled by CPLD chip. In this project this motor is used for the movement of robot..555 astable timer is used for producing a clock (square wave) at a desired frequency. It can be used in various ways like the astable mode, monostable mode etc. Here, we deal with the astable operation of 555. Astable mode ensures that the 555 is

self-triggered & so, it acts as a multi-vibrator. cell phone used is Nokia N95. Cell phone having symbian OS 9.2, N95 rel 3.1 operating system and dual ARM 11.332MHz processor is used. It is having built in Bluetooth and MEMS (micro electromechanical sensors) accelerometer.

V. WORKING PRINCIPLE

In this project the Bluetooth present in the cell phone is used in order to perform wireless communication with robot. The accelerometer used here is a built-in electronic component that measures tilt and motion. It is also capable of detecting rotation and motion gestures such as swinging or shaking. Hence by shaking or tilting the cell phone we are controlling the movement of the robot without pressing any button in the cell phone. The movement of the robot is controlled by using DC motor on the same hand the direction and speed of the motor is controlled by CPLD chip. The s/w in the cell uses the symbian OS and the program is c++ used to develop this applications. The s/w in the cell will read the MEMS data obtained when its tilted about the x or y axis. This data is then read by the s/w and then compared to the set data by the user. It will then send the same to the robot using the blue tooth technology. The Cell here is the master and the micro controller the slave and these both need to be paired before it sent to the micro controller. The s/w in the micro controller uses the embedded C program such that it will read the data obtained from the cell phone and then it will drive the robot in the required directions.

VI. SYSTEM IMPLIMENTATION

System implementation refers to putting a planned system into action. It is the stage of the system development in which hardware and software are acquired, developed and installed, the system is tested and documented. During system implementation, the initial work flow analysis may be redefined that had been completed as part of requirements analysis phase.

This section includes design details that are divided into different modules.

Hardware Module:

This module is responsible for accepting the control instructions from the Mobile Bluetooth and accordingly moves the robot.

Functionality of microcontroller:

This module is responsible for reading the control instruction from the Bluetooth through serial communication using USART. The Bluetooth is connected to PIC16F877A microcontroller of port C pins C6 and C7 which acts as transmitter and receiver pins.

This Bluetooth board is followed with a signal conditioning unit that will regulate the voltage signal from the Bluetooth before sending signals into microcontroller. Microcontroller is programmed using embedded C language. This microcontroller will convert the serial data into parallel at the output. Figure 6.1 depicts the control instruction received and their corresponding action performed.

Fig. 6.1: Microcontroller interfaced module

Functionality of CPLD chip:

This module will read the parallel signal data from the PICmicrocontroller which is transferred to CPLD chip through parallel communication. The CPLD chip is interfaced with timer circuit, driver circuit. This chip is programmed using VHDL language such that it will convert the data signals from the microcontroller into control signals which is require for the motor to run in the particular direction. Driver circuit is L293D ULN2003 series which takes the control signals from CPLD and control the direction of DC motor by sending directed control signals. 555 timer circuit is interfaced in order to provide clock and reset signals. Figure 6.2 depicts the CPLD interfaced module.

Fig. 6.2 : CPLD interfaced module

Software Module:

This module mainly consists of cell phone. Here, cell phone used is Nokia N95. It consists of built in MEMS accelerometer and symbian OS. The function of the whole system mainly depends on accelerometer and

OS used. Figure 6.3 depicts the cell phone containing inbuilt accelerometer and OS.

Fig. 6.3: Interfaced built in components in the cell phone
Functionality of MEMS accelerometer in cell phone:

In this module the MEMS sensor will read the signals when the cell phone is tilted in particular direction. The sensor API's in the MEMS will measure low-speed changes in inclination in the presence of gravity, detecting the change in the gravity vector, and determining whether the direction is clockwise or counterclockwise. The values are depicted in all the 3-coordinates(x, y, z). The values unit are in m/s^2 . Figure 6.4 shows Signal flow from cell phone to its inbuilt MEMS accelerometer

Fig. 6.4 : Signal flow from cell phone to its inbuilt MEMS accelerometer

Functionality of symbian OS the cell phone:

In this module the symbian OS will perform particular functions in order to move the robotic system in some particular direction. In this OS the application program is developed using symbian c++ language under carbide v1.2 platform. Figure 6.5 shows the signal flow from MEMS to OS and the Bluetooth.

The MEMS is designed in the symbian application such that it mainly performs three functions when it receives the data from MEMS sensors.

- I. It will remove the noise from the raw data obtained
- II. It converts the 3-coordinate value(X,Y,Z) into 2-coordinate system(X,Y)

III. It will compare the current data (X1, Y1) with the pervious stored data in order to predict the direction of the movement of robotic system.

Fig. 6.5 : Signal flow from MEMS to OS and the Bluetooth

Then at last the obtained values of (X, Y) are sent to builtin Bluetooth .This cell phone Bluetooth is interfaced with Bluetooth in robotic system. Then the data will be sent to the system through wireless communication.

TEST RESULTS

7.1 Test setup:

In this test setup first it has to check the hardware system design in order to check whether any errors in the connection, next test the system using cell phone which has to meet the required result.

Testing hardware module:

The robotic system must be first tested by giving control signals through hyper terminal (pc).Through Bluetooth hyper terminal is interfaced with the robotic system. Then as per the programming done in the hardware the corresponding keys in keypad must be pressed which will results in movement of robot in particular direction through wireless communication. This result predicts that hardware module doesn't have any defect.

Fig. 7.1.1 : Interfacing PC with Robotic system

Testing hardware module with cell phone:

In this the sis (symbian installation system) file and plug-in file must be installed into cell phone through Bluetooth from the pc after compilation of the code.

Then Bluetooth of cell phone is interfaced with the Bluetooth in robotic system by pressing CONNCET options in the cell phone. Then by selecting START option the position data sensed by the MEMS in the cell phone is transferred into the robotic system through Bluetooth socket. After that by changing the position of the cell or tilting the corresponding tilted data is sent to the system which will move the robot in corresponding direction. Then by selecting STOP option the movement of the robotic system will stop. At last by selecting DISCONNECT option the communication between cell phone and robotic system is disconnected.

Fig. 7.1.2 : Interfacing cell phone with Robotic system

7.2 Test Results:

Fig. 7.2.1 : Robotic system

Fig. 7.2.2: Installing sis file and plugin files after compilation to the cell phone and it is installed in application menu as BtCar.

Fig. 7.2.3 : Shows interfacing cell phone with Robotic system by searching devices through Bluetooth. SPP is the Bluetooth address name of Robotic system.

Fig. 7.2.4 : shows the selecting particular options in menu item. Start is selected when connection is existed and robot starts moving by tilting the cell phone. The system can be stopped by selecting stop option and it can be disconnected from the cell phone by selecting Disconnect option.

VIII. CONCLUSION

Symbian allows the developers to develop their own ideas by providing a very good library of API's. The application can run on different versions of the Symbian OS. It is backward compatible, i.e. application written for Symbian OS v7.0 can also run on v6.0. So it provides the reuse of code. Hence this application of robot controlling can be easily done using built in accelerometer and Bluetooth which can be further implemented for more advancement in robotic technology. Symbian OS allows mobile phone manufacture to customize the operating system, gesture can change way as per the system interact with the computer and mobile devices.

Mobile phones are most wearable computers currently available and have a ability to alter and manipulate our life. This application in real time helps in controlling the wheel chair or the robot or the toy car, with less physical efforts thus improving overall well being and quality of life. The symbian programming is very useful to control the hardware using the built in blue tooth of the cell phone and the blue tooth connected to the micro controller.

In this paper with the idea of implementing some advanced technology CPLD chip is used. Through this at a time up to 16 devices can be controlled posses 32- I/O PINS when compared with the microcontroller used in this system design through which only 10 devices at a time which has only 21- I/O PINS. CPLD having several advantages like reconfigurable controller, high frequency of operation, more number of inputs & outputs over conventional microcontroller. This can be easily modified according to future innovations as designed using small sub modules & reconfigurable controller.

With the available time and the facilities provided I would complete the project as required. This project is done for 2 axes and it can also be done for the 3rd axis also. Here symbian operating system is used but the same can also be implemented in further using the Android's latest operating system with graphics to make the whole system user friendly.

This paper is presented with the CPLD and the same can also be replaced with the FPGA with the boot ROM and can also replace the micro controllers used in the robot.

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