Wireless control of Robot using Accelerometer and Android Technology for Physically Disabled People

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Abstract

Recently, Android Phone Platform by Google becomes well-liked among software developers, due to its powerful capabilities and open design. We think it is an excellent platform for a robotic system control because it provides plenty of resources and already integrates plenty of sensors. Android provides the support of Sensors and Bluetooth. The goal of this project is to control a robot car using Android phone. The robot car is been controlled by the accelerometer sensor in mobile with x, y values and these values are send to the development board on robot car using blue-tooth. In this project, we can control the robot car direction by simply tilting the mobile in x, y directions, and is helpful for physically disabled people by creating an application in the Android phone. Here we are using the Bluetooth technology to interface robotic car to mobile wirelessly.

Introduction

In the recent times robotics plays a very important role in almost all the sector. With the introduction of robots in industrial environment the rate of growth of production raised with a good yield of output. Now with further decreased in the cost of robots and electronics, they have now started to move in the home environment and a lot of other commonly used applications. A wide variety of robots have been used for both commercial and domestic applications other than the industrial application. As their applications and usage have increased it is a tedious process to interact physically with each and every robot. So, now raises a question of how to effectively and efficiently interact with these robots. The complicated designed that is used in industries cannot be applied for domestic purposes. So now there arises a need for a user friendly environment which would help us to interact with them effectively in our daily life. The voice interface is a good one, but it is restricted to a lot of applications. So to replace it we shall be employing Gesture control. Several methods for the gesture recognition were employed, but all were only effective to 85%. We can freely move around with the limited range of wireless connection by using the data glove, whereas in vision based technique and user cannot move around limited range of wireless connection in vision based technique the Users are not supposed to move, they have stayed in front of camera. The accelerometer sensors used to control the robot, the main advantage is that it does not get affected by the natural things like magnetic field or magnetic field. So, that it’s becoming more popular when compared to the vision based technique.

The cost is low and also in smaller size of the accelerometers, is used to detect and identify human body gestures. As compared to the wearable sensor based control handheld gesture control is more suitable for controlling domestic robots and this can be achieved with the help of accelerometers in the smart phone.

Materials and Methods

Related Work:

The Modular Prosthetic Limb is controlled by grasping and reaching, both in online and offline. Three trials are made with the patient who was sitting in the bed. And in the table, he or she is holding with pressure sensor and one rest button is under their arm. When the patient press the button that will be sent to nearby receiver and the arm is start to by grasping and finally it will be reached to take an object. The above trails can be done by using EEG.

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The signals from the EEG are converted to data that will use to control the Modular Prosthetic Limb in the same room of a patient (Carlson, T., et al., 2013).

Brain to Computer interface is a technology to turn on or off the SSVEP system when want to or not, BCI is used to control the hand orthosis for a patient who is having Tetraplegia. In this paper they are moving their arm with four different ways of grasping an object. This can be done by using brain to computer interface device. An electrode is used to collect the signals from the human brain, that electrical signals are converted to data to identify by the computer. The computer is connected to the robot that helps the patient to move the orthosis with four different ways (Corcoran, P.M., et al., 2012).

In IT industries the development area is gaming. Here we can play games with your facial expression and eye movement to enhance the UI design that allows mode to play with the game smarter. The input for finding the facial expression is a low resolution video by using the Active Appearance Models algorithm. Here we can avoid wearable sensor for finding the face expression. The electrode is placed on the scalp of the human and the signals from the human are converted to data. The data are then used to play the game (Fifer, M.S., et al., 2014).

Brain to computer interface is used to assist the patient grasping and reaching movement of an object control. Here a human brain and the robot are interfaced to take an object by using Kinetic-based vision system. Kinetic based vision system is used to track a 3-D object, that information is transferred to the robot for grasping an object whenever a patient is thinking to get an object. The robotic upper limb is used to track the movement of the eye and the L-Exos is used for reaching movement (Frisoli, A., et al., 2012).

The computer is controlled by the human nervous by using the brain to computer interface device. Here the human brain outer layer is covered with the electrodes and the signal from the electrodes is received by the nearby receiver so that it can be used to drive the cursor in the computer (Kennedy, P.R., et al., 2000).

Brain-actuated wheelchair is designed for the patient who cannot able to walk. Here the brain of the human’s outer layer is covered with an electrode. A camera is fitted with the brain actuated wheelchair to interact with the environment, so that if there is any obstacles in the environment the wheelchair can move away from the signal from the electrodes. The obstacles from the environment are gathered by placing sensor the wheelchair (Ortner, R., et al., 2011).

Proposed Control Algorithm:

In this paper the proposed concept is that we shall be implementing the control of a robotic vehicle in a much easier and interactive way with the help of the Android platform. Here a smart phone is linked to a robotic vehicle with the help of a wireless communication technology called Bluetooth. An accelerometer is already present in all the smart phones which are available with the Android platform. Now what we do here is that we shall be transferring the signals obtained from the accelerometer present in the smart phone with the help of an android application through Bluetooth. Now based on the signal that is obtained from the Bluetooth the vehicle responds. This is very much useful in the process of remote surveillance and many other applications.

A. Accelerometer Sensor:

The Accelerometer sensor is used in the project for controlling robot’s movements. This sensor is used to find any changes in the vibration. An example for the accelerometer sensor is used in smart phones in smart phone there is one option called screen rotation, if we are tilting the mobile to the left the screen will rotate to the left. This can be done by this which can able to sense the vibration and send the value to the receiver so that the above process will take place. This is a core part in our project. The schematics of an accelerometer are shown in Fig. 1.

B. Ultrasonic Sensor, HC SR-04:

The movement of an object is identified by using the ultra-sonic sensor. This sensor is suitable for both indoor and outdoor applications. The ultrasonic ranging module HC - SR04 used is for obstacle detection purpose of the project. The ultra-sonic sensor provides 2cm to 40cm ranging from finding the object in the way. The trigger pin sends high level signal that is transmitted while the robot is in moving condition. If the signals come back with high level signal, then the information is transferred to the motor. Test distance = (high level time × velocity of sound 340M/S) / 2 in Fig. 2.

C. LPC 214:

The LPC2148 microcontroller are based on a 16-bit/32-bit ARM7TDMI-SCPU with embedded trace support and real-time emulation, that combine the microcontroller with embedded high-speed flash memory ranging from 32 KB to 512 KB. The maximum clock rate can be achieved by this architecture that allows 32-bit code execution. A 128-bit wide memory interface is also available in the ARM7 controller. It can be used in the application where small size and lower power consumption is required. In LPC2148, it consists of input, output ports, multiple UART’s, I ²C bus, on-chip static RAM is used for serial communication, software modems and also used in the voice recognition application. It also consists of low end imaging, larger buffer size and high processing power so that we can use for the application where high power is required. For industrial control and medical systems, ADC, which is 10-bit, DAC, which
is also 10-Bit, 32-bit timers, PWM channels and fast GPIO lines with up to nine levels or edge sensitive external interrupt pins make the LPC2148 microcontrollers suitable.

D. Design:

The block diagram of the accelerometer control of the vehicle through Bluetooth is given in the Fig. 4.

The brain of the system is the ARM microcontroller. This is responsible for executing all the commands that are received and also generates PWM pulses which are delivered to the motors. For picking the object a motor is fixed in the robot car so that it is useful for lifting an object. Based on the input code the robot will follow us

- Moves in backward direction
- Moves in forward direction
- Moves either left or else right when the comment is received from the motor.
- Moves in the opposite direction when an obstacle is detected by ultra-sonic sensor.

E. Hand Motion Recognition:

The handheld controller is a Smart phone that can be tilted in about the two axes. In our project the planned hand motions are represented below. The gestures consisting of rotational angle are too complicated for the controller to recognize it effectively. So we have avoided the third rotational angle. Here the third rotational angle is used as a negligible value of the consideration from the console of the smart phone. The given hand motions represented in Fig. 5 is the commonly used gestures. A user can easily use, these types of gestures. They are now translated to the corresponding robot commands.

F. Algorithm:

The application is initialized and the Bluetooth link is established. If the link is not established properly, then again re-establish the connection. Now hand motion is awaited. Once when the motion is detected it is converted into signals and the respective robot control command based on the algorithm is delivered to the robot.

The correct hand motion has to be performed. Once a wrong hand motion is given, an error is sent and waits for the correct hand motion. This shall be mapped to the robot control algorithm. The flow chart representation for proposed algorithm os showed in Fig. 6

G. Android:

Android is a mobile software for basic operation, primarily based on the Linux kernel and presently developed by Google. To create an application in the Android phone we can use the tool Software Development Kit (SDK) in the IDE environment by using the Android Eclipse software. The programming language to create an application is based on the Java programming language. While creating an application in an android phone we can choose your application name, icon, Android version and also we can design our application by coding in the activity XML page. After creating an application, we can run, test and debug our coding by using the Android virtual device.

Fig. 7. Shows the snapshot while creating an application on the laptop, in that we can give our project name, application name, Android version. After creating it, we can install in our Android phone.

H. Robot Control:

Fig. 8. Shows the sample appearance of my application in my android Phone. The application is created with the help of Android eclipse software using the Software Development Kit in the IDE environment. If you title your Android Phone to the left side the robot car will be moved to the left side. The lift up button in the application is used to move an arm towards up that is designed in the robot and the lift down button is used to move an arm towards down that is designed in the robot. The pick and the release button in the application used to pick and release an object capable of 200g. The information from the Android phone is transferred from the Bluetooth device to the Bluetooth module in the robot car.

RESULTS AND DISCUSSION

The design and implementation of the proposed algorithm are implemented with a four wheeled robotic vehicle shown in Fig. 9.

Initially the process of establishing wireless connection with through Bluetooth was configured and then the test run was conducted. The testing of the four natural gestures was started first. Based on the tilting of the smart phone in the two axis corresponding electrical signals were obtained and the vehicle responded to the programmed algorithm. The movement of vehicle in forward, backward, left turn and right turn was done successfully. The next level was that the testing of the vehicle’s motion with an obstacle in between its path movement was done and the vehicle resulted in a halt. During this stage only the reversing of the vehicle was possible and all the other direction responses were disabled. The snapshot is taken when the code is running in the Keil software for checking, correction in the code, and it is showing zero error. After that, the hex file is created from the Keil software for dumping the code in flash magic to implement it in hardware as shown in Fig. 11. If the dumping process is done, we can use the created application in Android phone for controlling a robot. Depending upon the command given in the phone the robot is moving by sending the
command to the motor in the robot car.

**Conclusion:**
In the proposed system, a wireless robot is designed using an Arm processor, motor driver, ultrasonic sensor, Bluetooth module and it's controlled by using android mobile by creating an application using Android Eclipse. Android mobile consists of Sensors and Bluetooth. It can be used to control the movement of the robot. The movement of the robot car is being controlled by the accelerometers in mobile with x, y values and these values are sent to the development board with robot car using Bluetooth. In this system we can control the robot car direction by simply tilting the mobile in x, y directions and also can be used to pick an object by using the button in the created application in android mobile. Here, for picking the object a motor is fixed in the robot car so that it is useful for lifting an object. The Ultrasonic sensor is used while the robot is in for detecting any obstacles in the way. Here we are using the Bluetooth technology to interface robotic car to mobile wirelessly. This system is mainly used for physically disabled people and also useful to do jobs in areas and in situations that are hazardous for human.

![Fig. 1: Schematics of Accelerometer](image1)

![Fig. 2: Ultrasonic Sensor](image2)
Fig. 3: Architecture of ARM LPC 2148

Fig. 4: Block Diagram for the Proposed Control Algorithm

Fig. 5: Hand Held Smart Phone Controller
**Fig. 6:** Flowchart of the Proposed Control Algorithm

**Fig. 7:** Snapshot while creating application

**Fig. 8:** Sample Appearance of Application in Android Phone
**Fig. 9:** Robotic Vehicle

**Fig. 10:** Code Executed using the Keil Software

**Fig. 11:** Dumped Hex file in Flash Magic Software
REFERENCES


