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Automated Guided Vehicle Using Kinect Sensor

Kotresh H M[1], Shabarish C Y[2], LakshmiBai A[2], Pavan V[2], Vivek K[2]

[1]*Associate Professor, Department of Electronic and Communication Engineering, East west institute of Technology, Karnataka, India.*

[1]*Student, Department of Electronic and Communication Engineering, East west institute of Technology, Karnataka, India.*

Corresponding Author: pavanvgowda95@gmail.com

Abstract: - In this project, we present a gesture human action recognition system for the development of a human-robot interaction (HRI) interface. Kinect cameras and the other sensor combination framework are used to obtain real-time tracking of a human action skeleton. Different gestures, performed by different persons, Quaternion's of joint angles are first used as robust and significant features. Next, neural network (NN) classifiers are trained to recognize the different gestures. This work deals with different challenging tasks, such as the real-time implementation of a gesture human action recognition system and the temporal resolution of gestures. The HRI interface developed in this work includes three Kinect and robot that can be remotely controlled by one operator standing in front of one of the Kinect sensor. Moreover, the system is supplied with a people action for control of the robot.

Key Words: — ***Controller,3-Ddepthimage,Interfacecontroller,Kinect.***

I. Introduction

The Main Heart of the Project is Kinect. The Microsoft Kinect sensor and its software development kit (SDK), the human machine interface of personal computers has achieved a new level where the users directly interact with human body movements. This new form of HMI has quickly spread to various dimensions including education, medical care, entertainment, sports. Traditionally, most Kinect applications employ body movements via the Kinect sensor to control a virtual object in software as a role in games. The recent trend, however shifting from software to hardware- based applications.

Initially Kinect is developed for Xbox gaming Console with Remarkable Features. The sensor enables the user to interact in virtual reality by means of body movements, hand gestures and spoken commands. It consists RGB color camera, infrared (IR) emitter, IR sensor to compose a 3-D image by providing 20 node points of human body as a stick in Cartesian Co-ordinate system.

This paper gives a brief overview of the latest research on mini robort controlling using Kinect. Till now the machines were used are either automated or remote control. These are remotely controlled by nRF, in this project, the machines are controlled virtually using a natural user interface (NUI) console "Kinect".

II. Related Work

Microsoft has introduced the Kinect and the specified SDK. The latest SDK Version compatible with Xbox 360 Kinect is Kinect SDK V1.8 and Microsoft has developed the Toolkit for it. It consists of all the API classes like skeleton class, voice recognition class and depth class. In this project skeleton class API is used. The skeleton class consists of 20 nodes (human body read as 20 nodes which joints are connected under rectMode). U can get clear idea by referring "Beginning with Kinect programming" described in the references and other references under reference section.

III. Technical details

A. Introduction to Microsoft Kinect

The Microsoft Kinect is a set of sensors developed as an Interactive Console the Xbox 360 & Xbox one too. Kinect has an RGB camera and a dual infrared depth sensor with a projector and CMOS IR Receiver (Sensor). The RGB camera has a resolution of 640X480 pixels and coming to the Infrared Camera, it is the basic Cause of Depth Imaging and Skeleton Building, which is used in developing the code. Using image, audio and depth sensors it can detect movements, identifies speech of players and also capable of interacting through human body motions [3].

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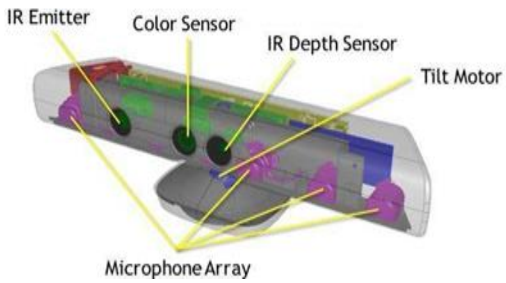

Fig.1. Kinect Sensor. 1. RGB camera 2. Depth Sensor 3. Microphone Arrays 4. Tilt motor.

The central camera is color camera which is a RGB camera that can identify a user's id or facial features and can also be used in augmented reality games and video calls. The two sensors make up the depth component of Kinect -an infrared projector and a monochrome CMOS sensor. These are used for gesture recognition and skeleton tracking. The purpose of microphone arrays is not just to let the Kinect device captures sound and also locate the direction of audio waves and it recognizes the voice irrespective of the noise and the echo present in the environment and the tilt motor is used to adjust the Kinect position according to the view. Kinect Deploying According to the present Project and its specifications shows below.

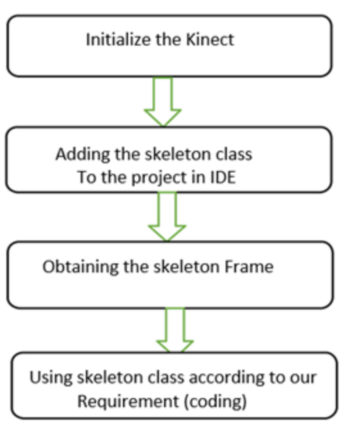

Fig.2.Kinect skeleton live stream flowchart

B. Kinect drivers and SDKs

At first, Microsoft didn't introduce any software tools to Interface the Kinect with PC, many developers came forward and Introduced Several Interfacing SDK'S. Later Microsoft Came with its own SDK tools to enable Kinect to interact with personal computer. It's basically an Open Source Platform and Developers Can Use Those References in it Like Skeleton Tracking, Speech Recognition etc... To play with Kinect. This Brought a Major Breakthrough. For, the Xbox Kinect 360 the latest SDK is V1.8. Which consists of the basic open source Projects (this will be WPF Applications) are available in C++, C# and visual basic language.

SDK enables developers to create applications that support gestures and voice recognition. The following are the supported operating systems for development.

Windows 7
Windows embedded 7
Windows 8
Windows 8.1
Windows 10

C. Kinect skeleton tracking

A program can use the depth information from the sensor to detect and track the shape of human body. The Kinect SDK will provide programs and skeletal position information that can be used in games and many other applications. This skeletal tracking in the Kinect SDK can track 6 skeletons at the same time. For which 4 of the bodies only simple location is provided but 2 will be tracked in detailed. For those 2 bodies the SDK will provide the position in 3-D space of 20 joint node positions.

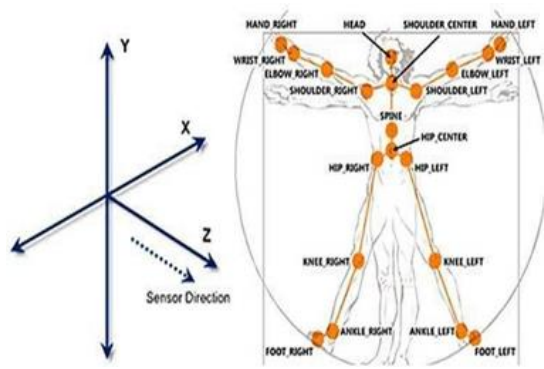

Fig.3. Shows the joint position and skeleton data

D. NRF Module

The nRF24L01+ RF module, a kind of sister module to the ESP8266 ESP-01 that allows users to add wireless radio frequency communication to their projects. The nRF24L01+ and the ESP8266 ESP-01 share similar form factors and pin layouts (and even look the same from afar!) but are controlled and function quite differently. In this tutorial, we hope to introduce the fundamentals of using this RF module, while also explaining how it communicates with other RF modules and microcontrollers. For the purposes of this tutorial, we'll be demonstrating interfacing the module with an Arduino Uno microcontroller.

E. Mini-Car chassis

Robot chassis is the latest robot platform. It has features of 2 gear motors with 65mm wheels and a rear caster (rolling movement of an object) and 12volt battery space and provides plastic rims with solid rubber tire.

F. Arduino

Arduino is an Open Source Electronics Platform with Integrated Micro-Controller on it. Since it is open platform many companies came forward to develop Arduino Boards with Integrated Sensors and Other Ways. Here, since there is a need of motors for the movement of mini-car, Arduino mini-motor control Board is used for reducing Circuit Complexity and this is provided by DAGU.

Arduino AVR (Advanced virtual RISC) board bridge motor control developed from "Dagu". The microcontroller used here is Atmega8A, in Atmega8A.It is a 16 pin IC. Some of the features of controller are high performance, low power, frequency 16MHZ, input voltage 5.4~9V, low dropout voltage 250mV @ 500mA,450mV@1A, the memory segments are 8kBytes of self –programming flash memory, EEPROM 512Bytes, SRAM 1Kbyte, i/o ports, timers and registers and it provides data retention i.e., it stores data for 20 years at 85°C/100years at 25°C. Some of the Board specifications are On-board 5-9V regulator power supply and dual channel DC motor driver up to 2A per channel. It supports up to 8 servos.

G. Arduino motor drivers

The Arduino controller is fitted inside the car to receive the control signals from PC and to control 2 motors through Bluetooth Communication. As the Virtual Driving the Motor Speed is Varied According to the user. To detect the human skeleton joint movement's one can remotely control the car to go forward, backward and to turn left, right. The Arduino controller interfaces with the Bluetooth Module in which the transmitting and receiving pins of Arduino are connected to the TX & RX pins of the Bluetooth Module. The Communication is through the Bluetooth USB Dongle with the Bluetooth Module which provides the Data to the Arduino Board.

IV. Block Diagram

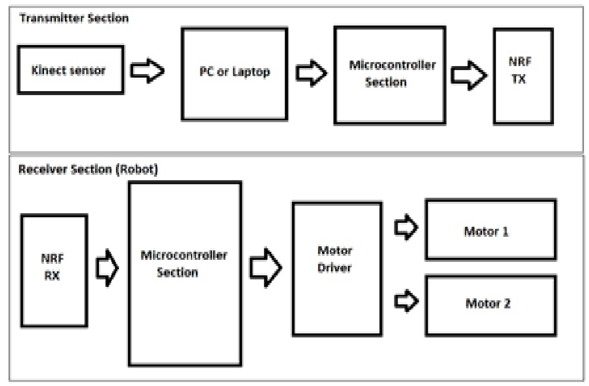

Fig.4. Block Diagram

The above block diagram explains the Kinect controlled car. The instructions from Human are read by the programmed Kinect. The Kinect reads the body movements of the person for every 600ms and this interval is given in the program

The instructions from Kinect are then passed to Arduino via Bluetooth communication. The instant instructions for every 600ms, Arduino mini motor driver controls the car according to the human Virtual Driving gestures. The velocity of the car varies according to the relative distance between hip node and hand node position. Let x is the position of the hip, which is fixed and y is the position of hand and this position referred in Cartesian co-ordinate system which is shown further.

V. Joint Orientation

It is a local axes representation hierarchical rotation based on a relationship defined by a bones on skeleton joint structure.

Table.1. Virtual Car Controlling Gestures

Human gesture	Car commands
Raise the both hands	Go forward
Turn the right hand	Turn left
Turn the left hand	Turn right
Both hands down	Stop

This node positions are referred in terms of Cartesian coordinates by the Kinect RGB camera and this will help in framing the code for the project.

Fig.5.Developing code

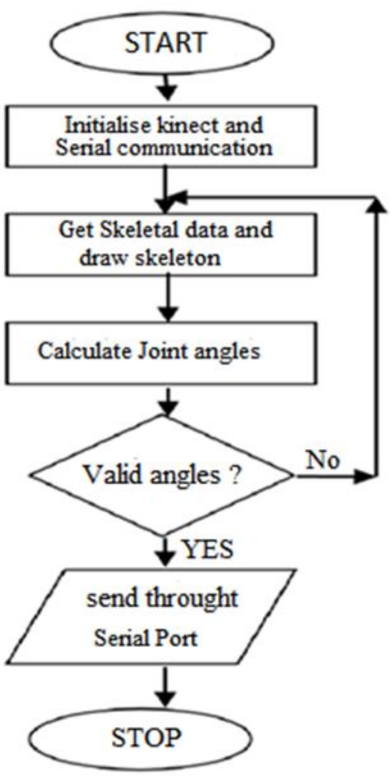

Fig.6. kinect to robo configuration flowchart

The turning of car depends on the relative linear velocities of the left and right wheels which in turn depends on the Cartesian co-ordinates of the above skeleton frame (according to code).

VI. Results and Conclusion

In this project, we propose a virtual controlling of a mini-car that uses skeleton tracking information provided by the Kinect. The experimental results are shown by human body skeletal positions. This provides virtual interactions directly with machines without any intermediate devices which results in human machine interface. The Results of the project are shown below

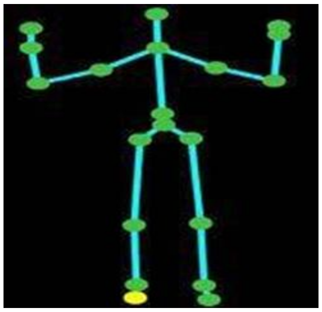

Fig.7. Gesture robo car go forward

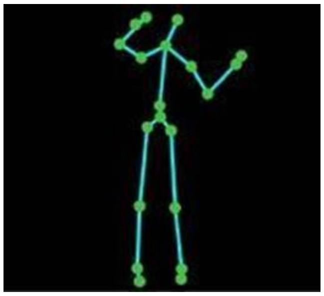

Fig.8. Gesture robo turn right

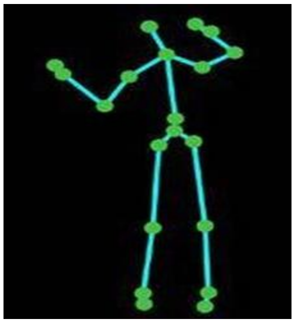

Fig.9. Gesture robo turn left

The above figures are the skeleton tracking from the Kinect and virtual motion of a robo.

In the future, there is a hope in development of the space expedition in other planets in which scientists can virtually experience the expedition and they can take care necessary objects. Also, can be sent to the place where people can't go and can break their curiosity.

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