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Human Follower Robot Using Kinect

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Abstract

This paper throws light on the aspects of human following robot using Kinect technology. The goal of this study is to eliminate the limitations of human robots by presentation of a Human follower robot which moves and is directly controlled by the human in front of the camera. This paper is focusing on the fact, how the Kinect sensor is capturing the 3-d information of a scene and recognizing the human body by retrieving the depth information. Microsoft Kinect is one of the latest advancement in the field of human and computer interaction (HCI). Various studies are being conducted using Kinect in the field of computer vision and action recognition techniques. In this process, the distance of human from the Kinect camera is being calculated in the form of the depth data, which is being Instantiated to move the robot forward and backwards. The robot being used here is a two legged robot powered by Arduino Uno microcontroller and a Bluetooth module (HC-05) for the interfacing and data transfer unto the robot. The whole process has a wide range of applications based upon application areas. The robot is independent of the particular human standing in front of him and will follow any other user after losing the field of view during its movements.

Keywords: **Human Follower Robot, Kinect Sensor, Human Computer Interaction**

1. INTRODUCTION

Robotics is a field that has seen much advancement in the past few years and before. This field has found many applications in the field of military, industry, medicine and many others. The absence of robotics in daily use has led to the need of an intelligent robot. Thus the human following robots come into action due to their capability as working assistants for the humans and the further developments can see these carrying heavy loads in the various hauling activities.

Currently this field is under many researches which use various technologies so as to locate the person standing infront of the camera using depth sensors and digital image processing. And Kinect camera has a quite less area limitation compared to the others along with its various qualities, this makes it the best in the business.[7]

Kinect sensors are versed with human tracking capabilities, which provide a full 3-D motion capture thus making it the backbone of the human following systems. The accuracy of the Kinect sensor can be judged by its capability to represent the full body of the human standing before it by showing 20 joints of the human body. The data calculated in the form of

the distance between the human and the Kinect camera is fed to the computer that is the bridge between the two systems- the robot and the Kinect.

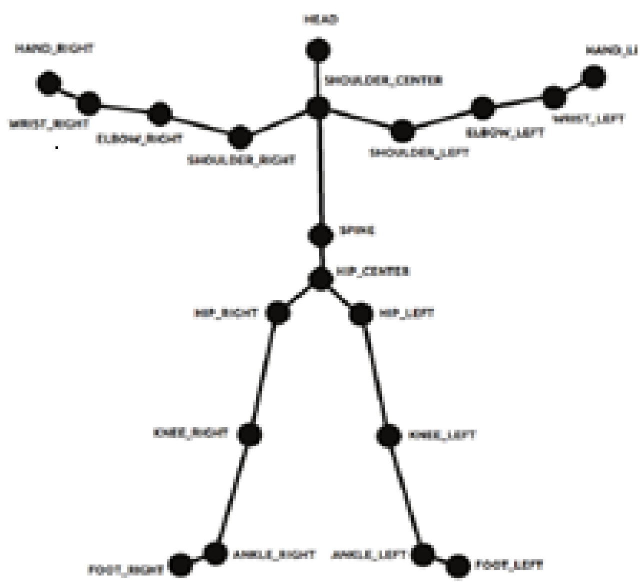

Figure 1: BODY JOINT RECOGNITION

2. ROBOT PLATFORM

The mobile robot used here is a two wheeled robot having approximate height of 0.15cms which is powered by an arduino uno microprocessor. There are two 9 volt batteries being used to power the whole system. The wheels are in direct connection to a dc motor for movement facility forward and backward.[6]

Hc-05 bluetooth module is being used in the form of wireless technology to make the system mobile, which can

be further improved by using infrared and laser communication systems to increase the range which is currently 10 metres.
The robot is capable of forward and backward motion currently obeying the movement of the human before it.

3. KINECT CAMERA

The Microsoft Kinect camera being used here in the project is one of the recent technologies developed in the field of image capturing and computer vision due to its 3d image and scene capture, depth calculation and action recognition facilities. The innovation behind the Kinect is a mixture of hardware and software contained within the Kinect sensor accessory that has various applications.[2]

Kinect has three basic components

1. Color vga video camera- This camera finds its applications in the field of facial recognition by
2. detection of the three color components- red, green and blue and hence its name – RGB camera. It stores triple channel data in the resolution of 1280* 960.
3. Depth sensor: The depth sensor present in this works in any conditions to see anything regardless of the light in 3-d[8]
4. Multi array microphone: The multi array microphone present in the Kinect camera has function of isolating the different voices from various sources thus making it capable of voice recognition. The main advantage being it can capture voices from a distance even.
5. Skeleton tracking: The Kinect skeleton tracking identifies the 20 joins present in the human body.

Figure 2: MICROSOFT KINECT

3.1 KINECT SENSOR

The range of this particular sensor is between 500mm to nearly 4000mm. Infrared is used so that the kinect sensors can see through glass. The infrared camera used is a monochrome complementary metal oxide semiconductor (CMOS) sensor. The main use is the quality of reconstruction of even a point in 3d.[3]
It produces a depth image map for the Infrared image. The depth value consists of gray functional values and darker the pixel means that the point is closer to the camera which fades in color accordingly to the distance.

Figure 3: DEPTH RECOGN ITION

4. METHODOLOGY

Human following : It is broken down into two steps:

1. Distance calculation: Every point in the space has 3 values (x,y,z) projected in the Cartesian coordinate system. The point (0,0,0) is the position of the sensor. The measurements of other points is measured with respect to the sensor only.
The depth is calculated by the z axis distance which is originally the distance between the point and the plane of the sensor. Thus the distance of the human standing in front of the kinect is the z-axis distance.[1]

Bringing it all together

var point= body.Joints[JointType.Spine].Position
var distance= Length(point)[4]

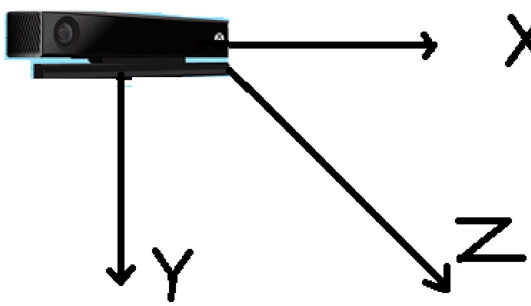

Figure 4: CARTESIAN COORDINATES OF POINT

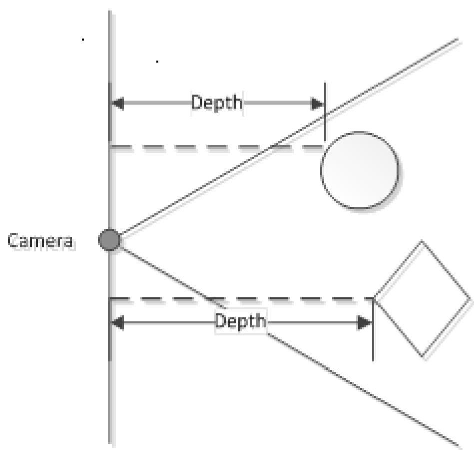

Figure 5: DEPTH CALCULATION

2. Data transmission to robot:

Using the depth value taken from the previous component and the location of the human target from the human target detection component(kinect), the robot is able to follow the human target and at the same time check if the distance of the_human target and the thresholds value. The robot classifies the movement in the following way[5]:

If depth is between the range of 2-4 meters: -

- Key A is pressed on the keyboard automatically without human touching.
- Robot automatically reads the key pressed and moves forward.

If depth is in the range of 1.5-2 meters: -

- Key B is pressed automatically on the keyboard.
- Robot reads the value and stops.

If depth is in the range of 0.5-1.5 meters:

- Key C is pressed on the keyboard.
- Robot reads the value and moves backward

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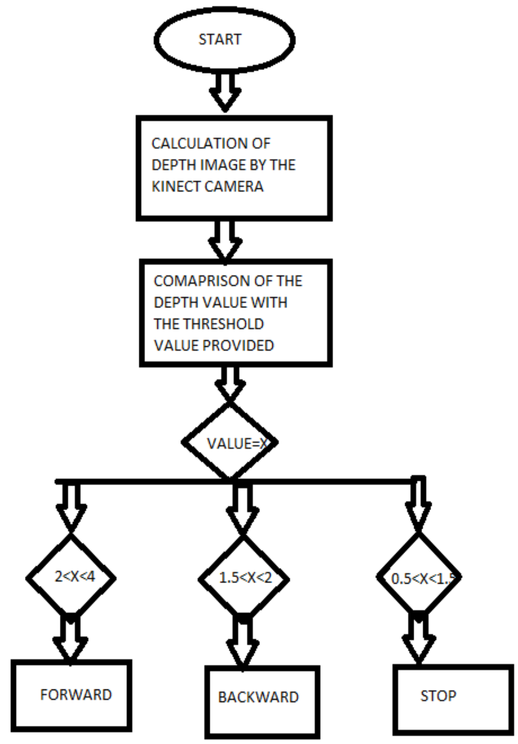

Figure 6: OVERALL ALGORITHM OF THE PROCESS

5. FUTURE SCOPE

Construction of the human follower robots is just in its starting phase. In future these can be seen as the ones carrying loads for the people of several disciples. Incorporation of large number of individuals will give a new direction to the scope of human follower robots.

6.CONCLUSION

We would like to conclude the topic by saying that a lot of further improvisations and improvements can be done so as to increase the efficiency and the overall working of the project. This system has a lot of applications throughout in every field and our proposed methodology makes an emphasis on control of the robot in human way thus making the task simpler. When the use of joysticks and wires are exempted, it increases the in situ qualities of the robot.

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