DESIGN AND DEVELOPMENT OF CONTROLLING MODULE USING LEAP MOTION CONTROLLER

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Abstract—In this paper we are proposing System, the main aim of a making human hand tracking system, is to create interaction between human hand and Electric devices in the home. Man-machine interaction gives the relation between human and computer. The Electric devices is to be controlled using Leap motion controller in X,Y and Z direction. The Leap Motion Sensor is a small device able to sense human hands above it and to keep track of them. Hence, when controlling the devices, the user will feel an interesting touch-free control experience. The electric devices can be controlled by translating the hand gestures into commands via leap motion controller. In this project the hand gestures are observed and transferred to the computer. Then by translating the incoming leap motion signals into commands we can control the electric devices. The main technology behind leap is natural user interface, gesture recognition and motion control.

Keyword_Leapmotionsensor,ImageProcessor,Gesture Control,Servo Motor,Rasberry pi

I. INTRODUCTION

The great advances achieved by robotics in recent years, have made it possible that this discipline of knowledge, has been considered a technology available only to large companies or research centers with million dollar budgets, to be practically available to everyone. The emergence of robotic applications has increased exponentially, so it is easy to see some of them in our daily lives. This series of advances have caused that the robotics it has also introduced as an educational complement in obligatory basic teachings, so robotics provides an efficient approach in the development of assisted devices due to its high functionality and thus it allows increasing the quality of life. The emergence of subjects such as mechatronics , in the current school curricula, it has allowed to provide to the robotics of a multidisciplinary character and to integrate at the same time several disciplines of knowledge. So, that the student during the educational process can easily appreciate the relations between the different subjects involved. Thus, the mechanical, electrical and electronic aspects are joined together with the control strategy, to implement the associated programming. In this paper an innovative and current application is presented. The objective has been the development and construction of a prototype of articulated robotic arm on a mobile platform and the implementation of a control strategy for gestures recognition (Leap Motion Sensor) through the natural movement of the forearm and hand. It has been chosen the use of recycled and reused materials in order to develop a prototype low cost. The robotic arm operates in 3D and during its development have been analyzed different motion transmission systems, simulating the degrees of freedom (DOF) of the human forearm. The idea has been to attempt that the system actions were similar to its real equivalent. Thus, several systems and new technologies have been integrated, such as the development of a control system based on the Leap Motion device, implementation of a hardware constituted and the manufacture of parts by means of 3D printing technologies; tools that sure will be relevant in the next years. Several examples of commercial devices to develop a control through gesture recognition Leap Motion devices. By means of gesture control it has attempted to promote user-prototype relationship. The objective is to show the usefulness of the theory with the resolution of a real case. Besides the gesture control strategy, it has been developed also in parallel, a control system through a set of switches and a graphical user interface, that allows the user to interact with the system. The initial objectives have been resolved satisfactorily. The prototype developed has exceeded the initial expectations and at low cost.

II. LITERATURE SURVEY

A) Whole-body humanoid robot imitation with pose similarity evaluation". Signal Processing

In this paper, they focus on the pose imitation between a human and a humanoid robot and learning a similarity metric between human pose and robot pose. In contrast to recent approaches that capture human data using expensive motion captures or only imitate the upper body movements, our framework adopts a Kinect instead and can deal with complex, whole body motions by keeping both single pose balance and pose sequence balance Author Jie Lei a, Mingli Song a, n, Ze-Nian Li b, Chun Chen 2014

B) Recognition of human motions for imitation and control of a humanoid robot

Most of the works in the field of tele-operation of humanoid robots do not use the whole-body of the robot to perform some task. This work treats the tele-operation of a humanoid robot through the recognition of human motions by using a natural interface mechanism. We propose the use of simple mathematical techniques to allow, in a satisfactory level, the user order in real-time a robot to mimic a person, to walk, to manipulate the environment with its hands and to perform some predetermined behaviors Author F. Zuher, R. Romero 2012.

III. EXISTING SYSTEM

In the last decades, there has been the need to perform tasks in places where the human presence is difficult, risky or even impossible. Thus, the robot manipulators have been mainly used in hazardous environments and repetitive operations [1]. After the 11 September 2001, Robin Murphy, a computer science and engineering professor at the University of South Florida (USF), said that the “robots will soon become like search dogs in the minds of the rescue community: essential” [2]. The USAR Robots (Urban Search and Rescue Robots) will be the first element to arrive at scenes of catastrophe or explosions. The need of new types of approaches on the rescue robots field is due to disasters of nature or hazardous environments that can’t allow the presence of human beings. Researchers have been developing types of robots that can operate at various dynamics situations with tele-operated, semi-autonomous, robots control. Tele-operated robots are expected to search and rescue victims in a disaster area, however the operator has to operate the mobile platform and the manipulator simultaneously [3]. With the current technology, most of the rescue robots are semiautonomous with end effectors since the robots are more reliable at certain autonomous tasks as: mapping, navigation and victim detection. With the advancement in the development of microelectronic devices has emerged new jobs using motion sensors with MEMS technology (Micro Electro Mechanical System). This project develops a system that can recognize the angle formed with the movement of the human fist. Technically is the instrumentation of the human arm with the use of an accelerometer in a Passive Haptic Glove, by a so-called programmable dissipation characteristic, that it is being used for controlling the robotic arm. The work is related to a kind of more natural and intuitive human-robot interface to the use in rescue robots.

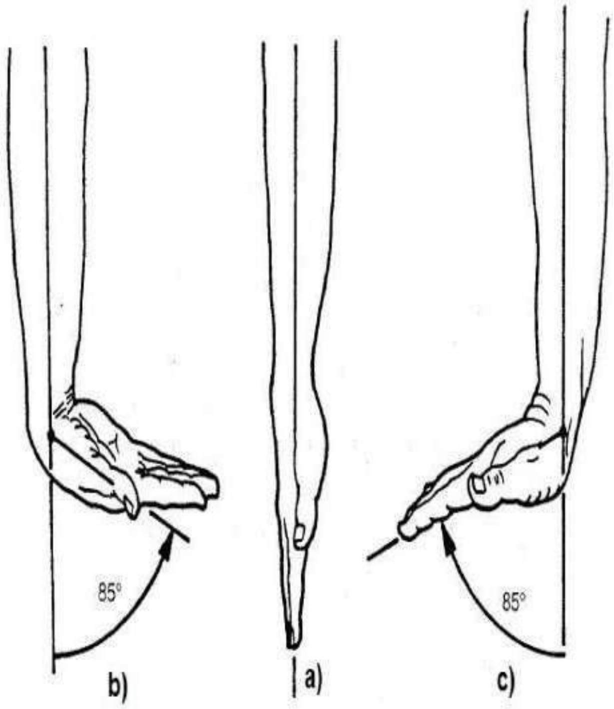

Fig 1.1

The human hand is a wonderful tool, that it is equipped with a functional richness that provides plenty of possibilities in the positions, movements and actions. From a physiological point of view, the hand is a “fulfilling end” of the upper limb and allows to adopt the most favourable position for a given action [4]. The fist is distal joint of the upper limb and allows the hand director segment put in a great position to hold [4]. The amplitude of the flexion and extension movement of the fist is used to define the position of the axis of the robotic arm, so that the angle is defined from the reference position, aligned with the fist as shown in Fig. 1a. The range of the flexion and extension is 85° for both positions as shown in fig as it reaches 90°.

Robots have certain human characteristics and among them, the most common is the mechanical manipulator that is built similar to human arm and fist [5]. This handler performs

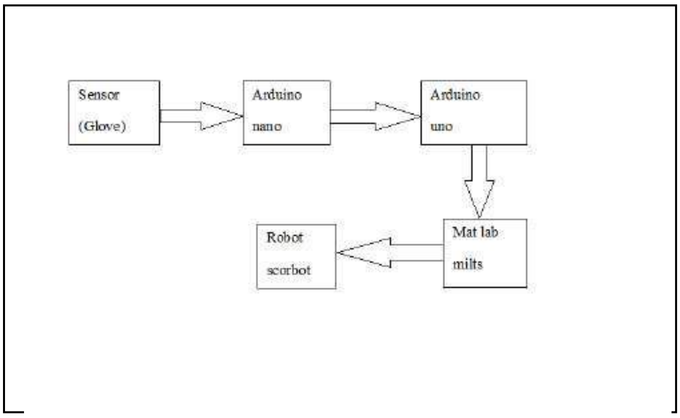

Fig 1.2

movements in space, capable of transferring objects, tools and special devices from one point to another, instructed by the controller and reported by sensors on the environment [6].The Scorbot-ER 4u is a didactic robotic arm manufactured by Intelitek Company of Israel. This robot does not have all the characteristics of applied in the industry, but allows reliable simulation of most features of industrial robots. The mobility of the manipulator is the result of a series of incremental movements, independent of one another, called degrees of freedom of the robot, and are determined from the number of joints [6]. The Scorbot has 5 degrees of freedom and it does not perform certain tasks that industrial robots with 6 degrees of freedom do. For example, the Scorbot does not perform yaw movement, lateral rotation of the tool handle [7].

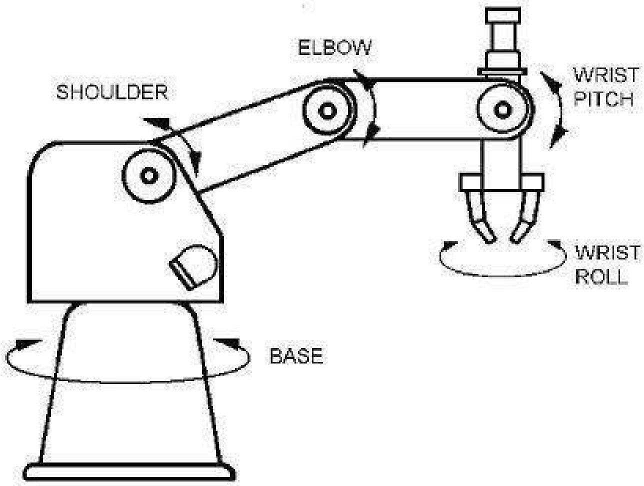

Fig 1.3

Accelerometer

An accelerometer is a device that allows quantifying the acceleration of a body. Its unit in the International System (SI) is m/s², but usually the value of the acceleration is specified as multiplicative factor "g". Thus, "g" is a unit of acceleration equal to the force of Earth's gravity at sea level [9]. The mechanical system available in accelerometers are developed under the principle of Newton's law [10]. A force F is is generated and the force is directly proportional to the product of the acceleration of a body by its mass. $F = m.a$ (1) There are several different ways for these devices convert the force F into electrical voltage values. This feature relates to the different construction methods of the accelerometers. The capacitive example is a mass m that is placed between two electrodes that function as a condenser. In applying a force, variations occur in the space between the fixed and movable plate of the capacitor. This variation is quantified into acceleration value [10]. The manufacture of these devices utilize MEMS (Micro Electro Mechanical System) technology and thus there is an assembly of mechanical and electronic structures of the integrated circuits. The MEMS-based sensors have replaced some of their precursors by presenting smaller size, lower cost, lower power dissipation and increased reliability of operation.

Noise Attenuation

The sensors are subject to random noises and disturbances, which can hamper the analyses and interpretation of data. For reading only the signals with the dynamic and components of interest in the system is necessary to use filtering techniques [16]. Therefore, we applied the moving average filter with a 7 samples window shown in Fig

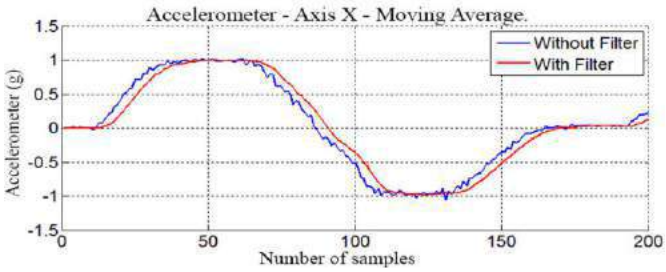

Fig 1.4

This type of filter uses a moving window of n samples to calculate the average of a sequence of records at each instant of time, its use has improved the signal with the attenuation of the sensor noise. In addition, it is one of the fastest filters to be computed just to be accomplished through basic operations.

Accelerometer Static

By placing the accelerometer so that a centre line in the direction of the gravitational direction, the respective axis output signal is corresponding to an acceleration of 1g even if the sensor is static [17]. On the other hand, if the axis orientation is parallel to the surface of the earth reading is 0g. From this, the accelerometer with tests were performed in a static position and parallel to the surface, sufficient condition for the acceleration signals of the three axes of the sensor thereby check the functioning.

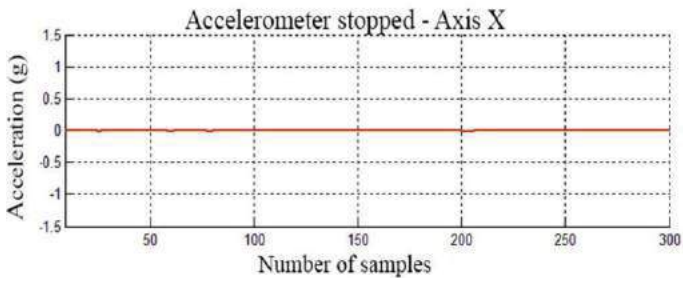

Fig 1.5

III. PROPOSED SYSTEM

In this system, we are using Leap motion sensor, because it analyzes the objects observed in the device's field of view. It recognizes hands, fingers, and tools, reporting discrete positions, gestures, and motion. The controller's field of view is an inverted pyramid centered on the device. The effective range of the controller extends from approximately 25 to 600 millimeters above the device (1 inch to 2 feet). The controller itself is accessed and programmed through Application Programming Interfaces (APIs), with support for a variety of programming languages, ranging from C, C++ to Python , JavaScript, Objective-C. Recently many robotic arm is used in industries which will work in accordance to the program, such as lifting the object, placing the object, drilling etc. but these robots are trained, any change in the working of robots will change the program, but with this idea we can function whatever we want to do without much change. Leap motion device is connected to a particular port of PC.The value from leap motion device will be got from the com port by using Python.Then the value is sent to the controller through Serial transmission .The controller receives the values from the PC via UART (Universal Asynchronous Receiver Transmitter). According to the values the Robot module will be driven.

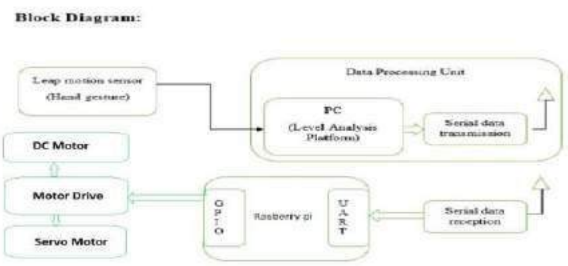

Fig 2.1

The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products include an auto router and basic mixed mode SPICE simulation capabilities.

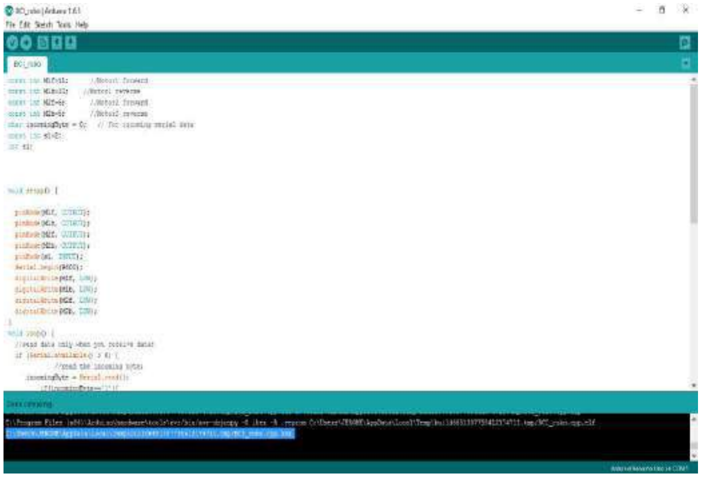

Fig 2.2

Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is included with all product configurations. The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables it's used in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design It also finds use in the general hobbyist community and, since no hardware is required, is convenient to use as a training or teaching tool Support is available for co-simulation.

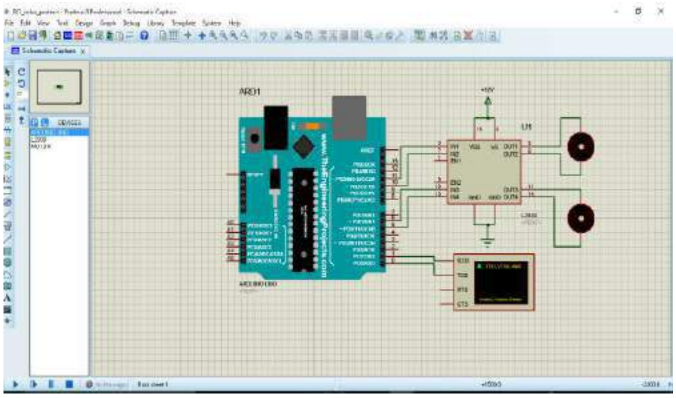

Fig 2.3

Microchip Technologies PIC10, PIC12, PIC16,PIC18,PIC24,dsPIC33 Microcontrollers. Atmel AVR (and Arduino), 8051 and ARM Cortex-M3 Microcontrollers NXP 8051, ARM7, ARM Cortex-M0 and ARM Cortex-M3 Microcontrollers. Texas Instruments MSP430, PICCOLO DSP and ARM Cortex-M3 Microcontrollers. Parallax Basic Stamp, Free scale HC11, 8086 Microcontrollers.

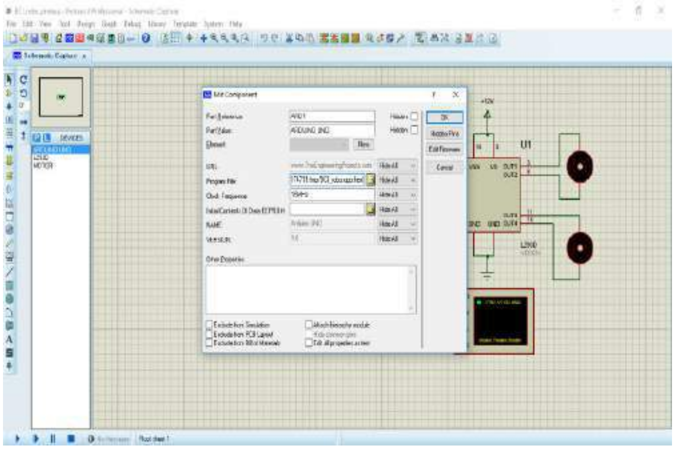

Fig 2.4

The PCB Layout module is automatically given connectivity information in the form of a net list from the schematic capture module. It applies this information, together with the user specified design rules and various design automation tools, to assist with error free board design. Design Rule Checking does not include high speed design constraints. PCB's of up to 16 copper layers can be produced with design size limited by product configuration.

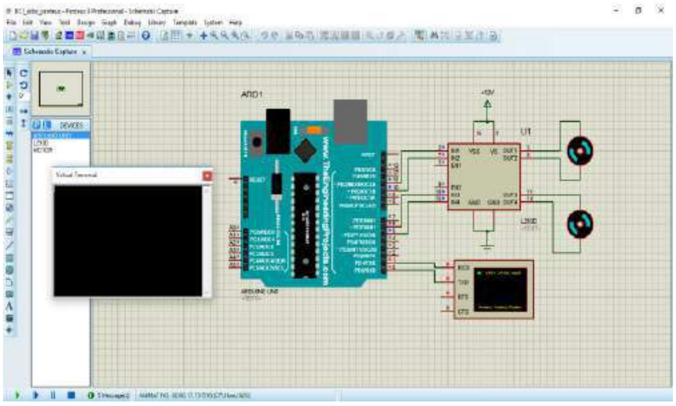

Fig 2.5

CONCLUSION

In this work was demonstrated that is possible to perform a satisfactory tele operation taking into account the Design and development of robotic control using Leap motion sensor mechanism to be the vision of the robot. For persons of a society in common, we believe the less interruption in their knowledge about how to interact with robots the better a social and natural interaction is produced. That is, to make possible the human agent communicates with a robot using just his/her natural ways – such as the movements of the human body – is one of the best ways to integrate robotics in a social way. Regarding to future works, it is clearly recommended the use of approaches of avoiding of auto-collision among the limbs, and a stable balance module to works that approach mimicry and control of humanoid robots through direct control. Man-machine interaction gives the relation between human and computer. The Robotic module is to be controlled using Leap motion controller in X, Y and Z direction. The Leap Motion Sensor is a small device able to sense human hands above it and to keep track of them. Hence, when controlling the robot, the user will feel an interesting touch-free control experience. A mobile robot can be controlled by translating the hand gestures into commands via leap motion controller. In this project the hand gestures are observed and transferred to the computer. Then by translating the incoming leap motion signals into commands we can control the robot. The main technology behind leap is natural user interface, gesture recognition and motion control.

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