COMPUTER-AIDED NOURISHMENT SYSTEM FOR AMYOTROPHIC LATERAL SCLEROSIS AND MULTIPLE SCLEROSIS PATIENTS

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Abstract

Individualism is one of the indispensable necessities of today's world. Especially for disabled people it is limited. It is a natural feeling and a right to be self-nourished. This is a basic individual right and also constitutionally granted around the globe. This project aims to self-nourish ALS and MS patients with the assistance of a robot arm. The project only needs a PC, a HD webcam and a robot arm to operate. In this project computer screen offers four different kind of meals, an accept button and a cancel button at the beginning. A HD webcam observes the patient's head and sends the visual data to the head movement detection program to move the mouse. At the same time period another program is running to provide the GUI and the serial connection with the robot arm. When patient moves his head and waits the meal become selected, then an instruction appears and accept-cancel buttons become enabled. The patient is expected to choose one of these buttons. If the accept button is selected the position of the selected meal is delivered to the robot arm. Positions of the meals are fixed and all the data sent through the RS232 port. In communication circuit the voltage levels are adjusted and the data canalized to the servo motor driver circuit. In the servo motor driver circuit a PIC exists to drive servo motors. The code in the PIC listens to the incoming data. If an acceptable input received the data is send to the servo motors; and the spoon is delivered to the patient. When morsel is finished patient can select continue the meal and the program rewinds to the initial state..

Keywords-ALS; MS; Assistive device; Nourishment; Robot arm

Introduction

The project aims to promote the Amyotrophic Lateral Sclerosis and Multiple Sclerosis patients to take their nutrition individually. A HD camera, a PC with a monitor and a Robot arm are utilized as hardware. At the software side Image processing, serial communication, PIC programming and GUI making techniques are used.

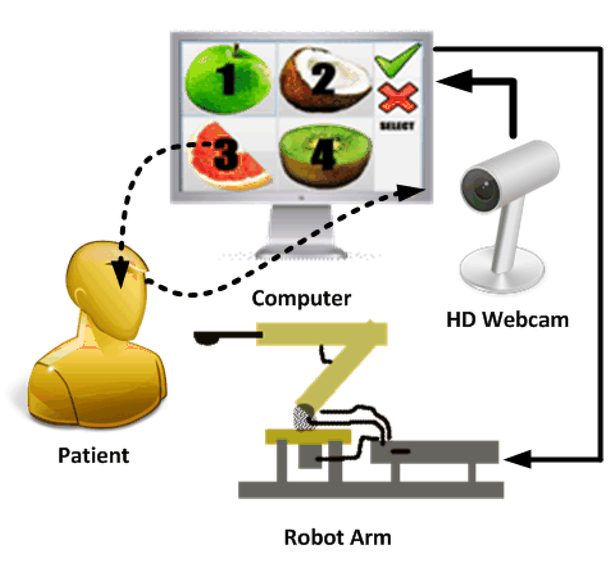
Materials and Methods

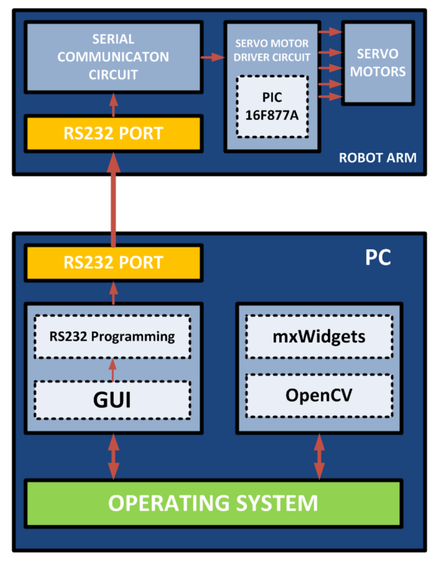
Electronic Parts

In order to rotate the parts electric motors is required. Servo motors are capable of higher resolution of position control. PIC microcontrollers are required to control servo motors. Because of their low cost, flexibility of programming and availability in market they are very popular. Required PIC microcontroller must have a programmable flash; PIC16F877A is the best device for this purpose. The serial communication circuit supplies its power from the servo motor driver circuit in this circuit it is required to adapt voltage from TTL level to RS232 level. So, this adaptation is obtained by MAX232 integrated circuit. PIC16F877 microcontroller is the most important part of the circuit design of the circuit is strongly dependent on the specifications of this component. Integrated circuit of 78L05 is used to adjust voltage levels.

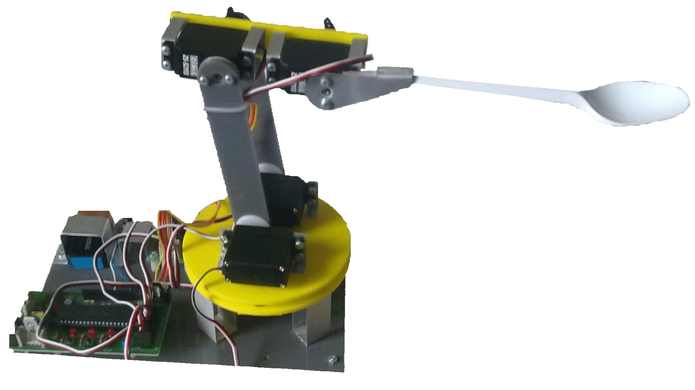
Programming

While programming the PIC the microC language is preferred. Initial values are set to values that robot arm stay at an reasonable position. Then an infinite loop created to control existence of incoming data. If an incoming data occur the incoming data package is processed.





Incoming data package consists of a "*" sign, values of all possible servo motors and a checksum. After converting the code into the hexadecimal form, it is also required to load it into the PIC. For this purpose a PIC burning Software must be used.



Serial connection is set to 19200 Bps as it was set in the PIC programming. Servo motors change their position by the length of the signal applied. These signals are applied by the PIC and the hexadecimal location variables are given by the PC. After a couple of trial the values needed can be acquired and can be applied by starting with "*" symbol after the initial signal the desired location data for the entire possible servo set in decimal must be sent. Finally a checksum is also sent to operate the robot arm properly.. Head tracking is also one of the issues in this particular project. An open source project eViacam is used to deal with the problem. eViacam uses C++ and OpenCV, wxWidgets libraries.

Evaluation

The GUI of the system is tested with 10 healthy individuals; all of the participants are able to perform given tasks. According to the questionnaire applied and; majority of the participants strongly agreed the ease of competition of tasks and strongly agreed or agreed the ease of pointing what they wanted. Adaptation speed issue is also in acceptable level. Participants also agree the flow of instructions is clear in acceptable levels.

Future Work

For the further development, the full scale of the model must be constructed. Mechanical Engineering, Electronic Engineering, Biomedical Engineering, Medicine and Rehabilitation departments must be included into the project. Using another camera to detect plates on a table will make the project more applicable to the real life scenarios. Using two cameras instead of one will grant the project binocular vision. It allows locating the depth of the head; and if another image processing applied to find the mouth the spoon can be directly delivered to the patient's mouth. Another future work is eliminating the PC. Low-cost and low-power devices must be used in the project. Changing the PC with a FPGA increases mobility, saves power and most importantly reduces the costs.