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Gesture Controlled Mobile Robotic Arm Vehicle Using Accelerometer

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Abstract - *In this paper a model to control robotic arm via gesture using accelerometer is presented. Accelerometer is a three axis device which is mounted on the human hand in order to perform the action of the robotic arm as per the actions performed by the human hand. The microcontroller used is a PIC microcontroller, it is programmed to take analog reading as input from accelerometer and to transmit the signal at the receiving end of the robotic arm. The DC-motor are used to achieve the movement of the robotic arm, they are those actuators which continuously rotate like stepper motor. These motors are used where there are requirements for the continuous rotation, hence it is used to drive the wheels. A gripper is used to facilitates the pick and drop facility of the arm. The gripper is placed on a mobile platform to provide movement from one place to another. The main goal is to control the robotic arm via human gesture in a wired fashion with ease in motion over a given range.*

Key Words: ADC, MCU, Gesture, Accelerometer, DC Motor, PIC, Gripper, Mobile Platform.

1. INTRODUCTION

In today's world, the integration of robots in working tasks has been increasing in order to replace the humans and especially for those actions where repetitive tasks are required. Robotics is classified into two areas, Industrial Robotics and Service Robotics. These robots are used in fields of military, hospital, radio-active areas etc. Since there are many places where it is very dangerous for human to work like in Radio-active areas, diffusion of bombs etc., therefore robots are replacing humans in many areas to do their work and with much more precision [1]. There are many ways being implemented to control the movement of a robotic arms like Motion sensors & markers [2], vision systems [3] etc. Using an accelerometer as a gesture recognition device is quite popular due to its small and thin size and low moderate cost.

Robotic arm is a robot manipulator, it is usually programmable, with much similar functions to a human arm. It is linked by certain joints which allows either rotational motion or translational motion. To perform any desired task such as, gripping, spinning etc., depending on the need the end effectors can be designed. Robotic arms can be autonomous or manually controllable which can be used to operate a variety of tasks with great precision. Robotic arm may be fixed or mobile and can be designed for a wide variety of applications. In some, the precise controlling of the robotic arm is of utmost importance. Currently, Robotic arms are controlled using joysticks. To make controlling of an arm with more precision like human arm we have designed an arm which is synchronized to human arm and can imitate the actions of a human arm. Robotic arm whose aim is to replicate the movements of a human arm using accelerometers as sensors for the data gaining of the natural arm movements. This technique of control allows better elasticity in scheming the robotic arm relatively than using a controller where every single one is separately controlled. Processing unit handles each motor's control signal in accordance to the inputs from the accelerometer, in order to imitate the movements of the human arm [1].

2. RELATED WORK

Gesture control is becoming a popular method in many applications and various works has been implemented in this area. Industrial arms like MOTOMAN HP6 based on learning and Artificial Neural Networks is current related work on this technology[4] . Some researchers[5] used Kinect at Humanitarian Technology (HuT) Labs of Amritathat involves the building of a Robotic arm which mimics the motion of the human arm of the user. The system monitors the motion of the user's arm using a Kinect. The skeletal image of the arm obtained using the "Kinect Skeletal Image" project of Kinect SDK, consists of 3 joints and links connecting them. Coordinate Geometry is used to calculate the angles between the links connecting the joints. This gives us the angles for a 3D representation of the human arm. Also, some researchers implemented a Gesture Actuated Robotic Arm [6] using MEMS- accelerometer sensors placed on different joints of human hand. Researchers also worked on an Integrated Vision-based robotic arm interface for operators with upper limb mobility impairments[7] which was developed to operate a commercial wheelchair-mounted robotic manipulator (WMRM)

3. PROPOSED MODEL

The model consists of the transmitting and receiving part. The system can be understood better with the help of flow chart as shown in figure-1.Transmitting and Receiving circuit is shown in figure- 2. Accelerometers are mounted over a glove which is worn by human hand. The unit contains an accelerometer, a microcontroller (PIC 16F877a) for processing the signals and analog values from accelerometer. These signals are then transmitted to the receiving part on the basis of which the actuators operates.

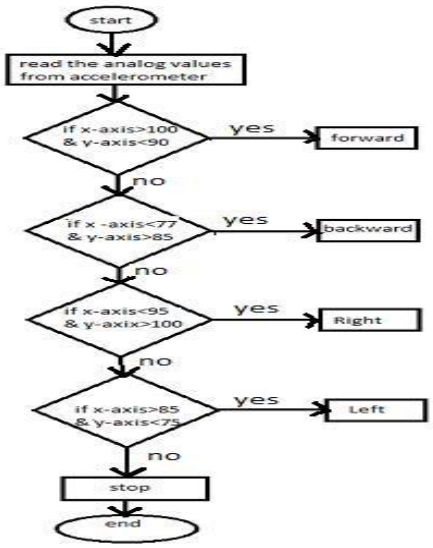

Figure-1 Flow Chart of the proposed method

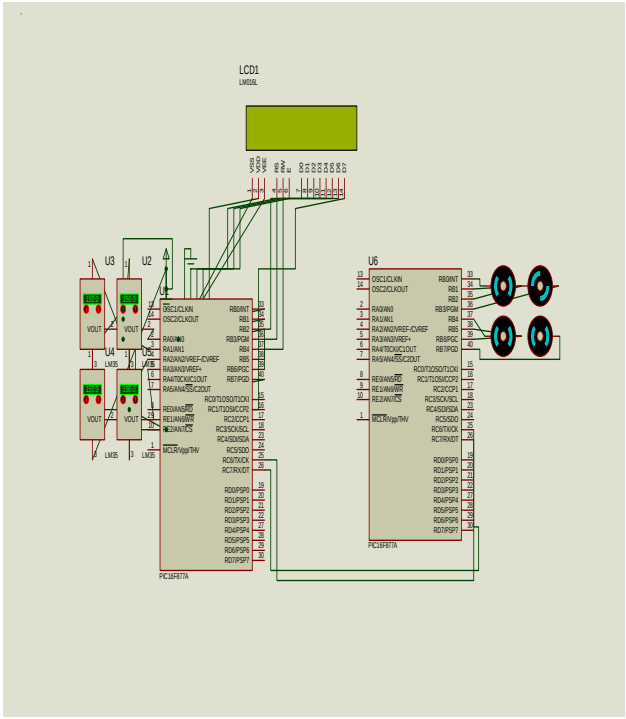

Figure-2 Transmitting Circuit & Receiving Circuit

4. IMPLEMENTATION

SOFTWARE USED:

The program is written on MPLAB in EMBEDDED C. The Simulation is performed on the Proteus.

HARDWARE USED:

Microcontroller

The PIC microcontroller PIC16f877a[8] is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many **projects**. PIC16F877A also have many application in digital electronics circuits.

Accelerometer

The ADXL335[9] is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. It has 6 pins. 3 pins is for X,Y,Z axis. First pin for power supply (VCC), second pin for ground (GND) and the last one for self-test (ST). It operates on 3.3V. The X-axis and Y-axis of one is connected with the A0 and A1 of microcontroller and the other X and Y axis are connected with the A2 and A3 of the microcontroller.

Motor Driver

We have used L293D[10] IC which is 16 pin DIP package motor driver having 4 input pins, 4 output pins, 4 VCC pins and 4 ground pins. All 4 input pins are connected to the output pins of decoder IC. And 4 output pins are connected to the DC motors of robot. We have connected all 4 VCC pins to 5V DC supply.

PMDC Motor

The permanent magnet DC motor consists of an armature winding as used in case of a usual motor, but does not necessarily contain the field windings.

5. LIMITATIONS AND FUTURE WORK

- The on-board batteries occupy a lot of space and are also quite heavy. We can either use some alternate power source for the batteries or replace the current DC Motors with ones which require less power.
- Secondly, as we are using RF for wireless transmission, the range is quite limited; nearly 50-80m. This problem can be solved by utilizing a GSM module for wireless transmission. The GSM infrastructure is installed almost all over the world. GSM will not only provide wireless connectivity but also quite a large range.

Thirdly, an on-board camera can be installed for monitoring the robot from faraway places. All we need is a wireless

camera which will broadcast and a receiver module which will provide live streaming.

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