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Design And Implementation Unit Electronic Gesture Recognition Using The Accelerometer To Control The Robotic Arm Developed With Cortex-M3 Core

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Abstract:

Mechatronics is one of the promising trends in the era of computing in industry automation and control system today. The proposed project is one such attempt to design an accelerometer-based system to communicate with an industrial robotic arm wirelessly. This project involves the design and implementation of robotic arm driven based LPC1768 Cortex-M3 core. The core has to be interfaced with DC motors robotic arm to control the movements of the robotic arm. ADXL335 accelerometer is a three-dimensional sensor used for this purpose, the accelerometer sensor of gesture capture human forearm and produces three analog output voltages on three dimensional axes. And two flexion sensors are used to control the movement of grip. For the different movements of the accelerometer and flex sensors are sent to the corresponding characters Cortex-M3 core wirelessly using 2.4GHz RF module. And depending on the character received robotic arm can be controlled in static or dynamic mode through communication with the EEPROM using the I2C protocol

***Keywords**: Accelerometer,Roboticarm,Arduino,RF transceiver, CORTEX M-3, Networking.*

1.Introduction

More recently, industries have introduced more flexible forms of automation in the manufacturing cycle. Programmable mechanical manipulators are now being used to perform such tasks as spot welding, spray painting, material handling, and component assembly. Since computer controlled mechanical manipulators can be easily converted through software to do a variety of tasks.

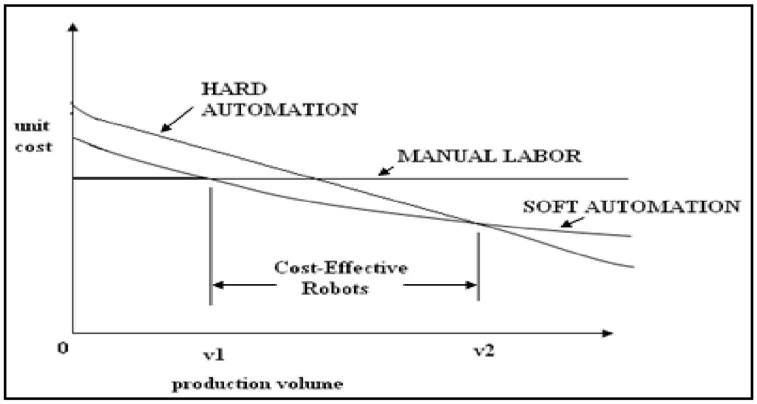

Figure 1: Relative cost effectiveness of soft automation

For low production volumes, such as those occurring in small batch processing, manual labor is more profitable. As production volume increases, there comes a point (v1) where robots become more profitable than manual labor. As production volume increases further, eventually reaches a point (v2) where hard automation exceeds both labor and robots in cost-effectiveness. The curve in Figure 1 is the representative of the general qualitative trends with accurate data depend on the characteristics of the unit being produced. Robots are generally used to perform the hazardous, highly repetitive and unpleasant. Most robots are configured for operation by teaching technique and repetition. In this way, a trained operator (programmer) typically uses a portable control device (a handheld) to teach a robot its task manually. This programming and control of robotic arm movements through the use of handheld robot is still a long and difficult task that requires expertise. Therefore require new and easier ways to program the robot. The aim is to develop a methodology with a high level of abstraction that simplifies the programming of robots .

In this paper we propose a gesture recognition system based accelerometer controlling an industrial robot in a natural way. A wireless 3-axis accelerometer is attached to the human arm, catching her behavior (gestures and postures). A system formed is used to recognize gestures and postures. Finally, several tests are performed to evaluate the proposed system.

2. Block Diagram

Most industrial robots are programmed still using the teaching process typically through the use of the robot teaching pendant. The proposed project is an accelerometer based system for controlling an industrial robot arm wireless 3-axis accelerometers.

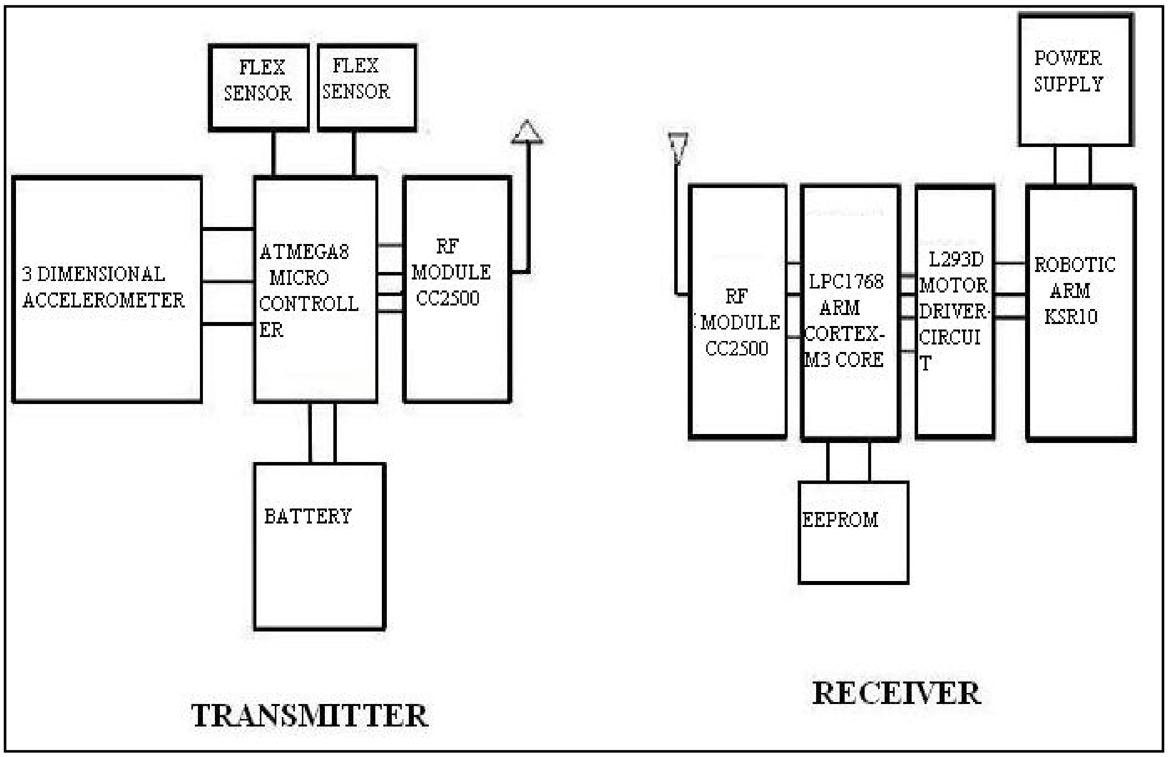

Figure 2: Block Diagram of the System

Most industrial robots are programmed still using the teaching process typically through the use of the robot teaching pendant. The proposed project is an accelerometer based system for controlling an industrial robot arm wireless 3-axis accelerometers

3.Robotic Arm

A robotic arm is usually programmable, with similar functions to a human arm. Manipulator such links are connected by joints that allow either the rotation or translation movement (linear). This robotic arm includes various parameters such as the weight of each link, the weight of each set, the weight of the object to be lifted, the length of each link, the degree of freedom workspace.

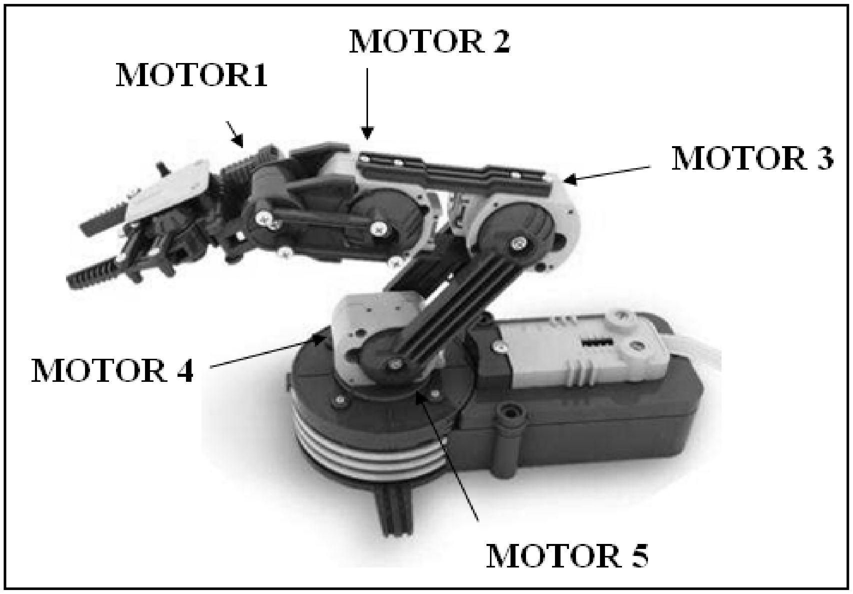

Figure 3: Robotic Arm

In this project we are using KSR10 a five-axis robotic arm. This kit comes with all mechanical modules that are required to build the robotic arm, are the gears, couplings, motors, clamps, screws, etc ... By using these modules must be mounted robotic arm. As shown in Figure 3 has five DC motors, these DC motors are interfaced with LPC1768 Cortex M3 core through L293D controller circuit.

4. Gesture Recognition

Accelerometer sensor is mainly used for gesture recognition. An accelerometer is a 3-axis device that measures the vibration or the acceleration of the movement and produces different voltage potentials. The force caused due to vibration or a change in the acceleration causes the dough to produce an electrical charge that is proportional to the force exerted on it. Since the load is proportional to the force, and mass is constant, then charge is proportional to the acceleration.

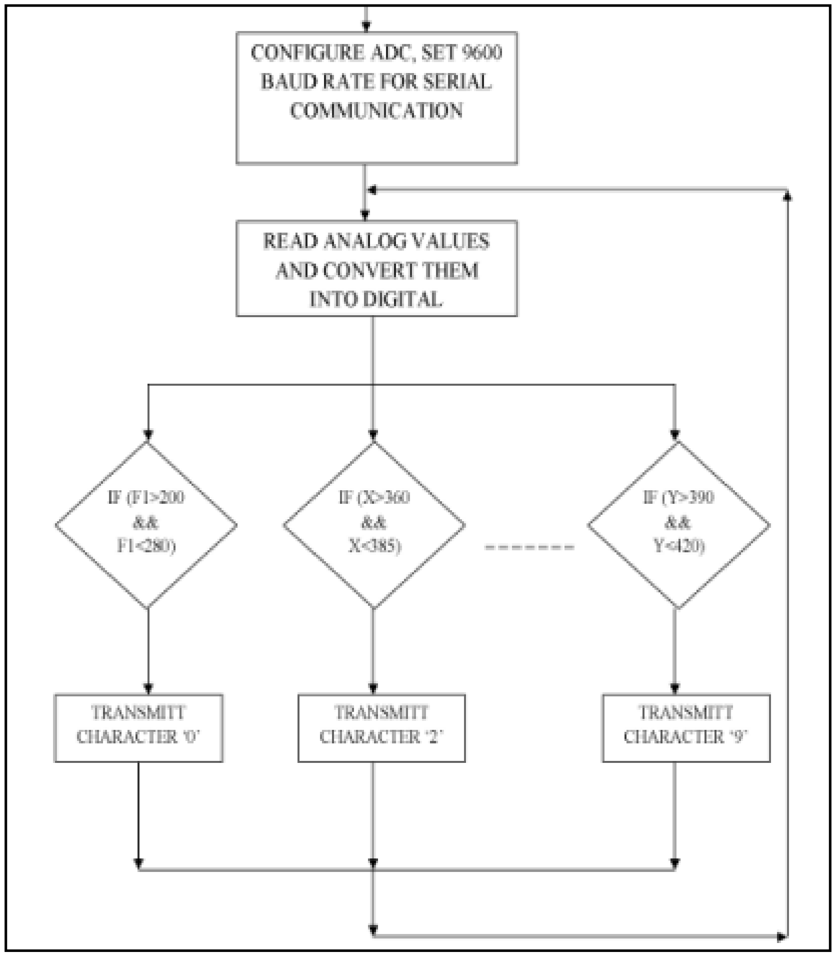

Figure 4: Transmitter flow chart

In this project we are using accelerometer ADXL335 is a 3-dimensional accelerometer. This plate of measuring acceleration in three dimensions (X, Y and Z) and produces three different voltage levels. And we are using two sensors to control flexible pincer movement. Flex sensors are sensors that change in resistance as a function of the amount of curvature in the sensor. Convert the change in the electrical resistance curve - more than doubled over the value of the resistance. The output of the deflection sensor and accelerometer are analog in nature, to convert analog signals into digital format, use embedded microcontroller's ADC Atmega8 .

Here, ATMEGA8 microcontroller continuously read data from the accelerometer and flex sensors, and convert them into digital format. These digitized data were compared with data that has already been adopted in the bending part accelerometer and sensor analysis. And every movement of the accelerometer are assigned some characters. Now, comparing the phase of the digitized data is compared to predefined ranges, and corresponding character matched range transmitted through 2.4 GHz RF transmitter

5.Controlling Mechanism

To control the various movements of the robotic arm that we are using ARM Cortex-M3 LPC1768 micro controller board. The LPC1768 is an ARM Cortex-M3-based microcontroller integrated applications that offer a high level of integration and low power consumption. The ARM Cortex-M3 is a new generation core that offers system enhancements such as enhanced debug features and a higher level of support block integration. The microcontroller operates at a frequency up to 100 MHz CPU and CPU incorporates a 3-stage pipeline and uses Harvard architecture with separate instruction and local data buses and a third bus for peripherals. [8].

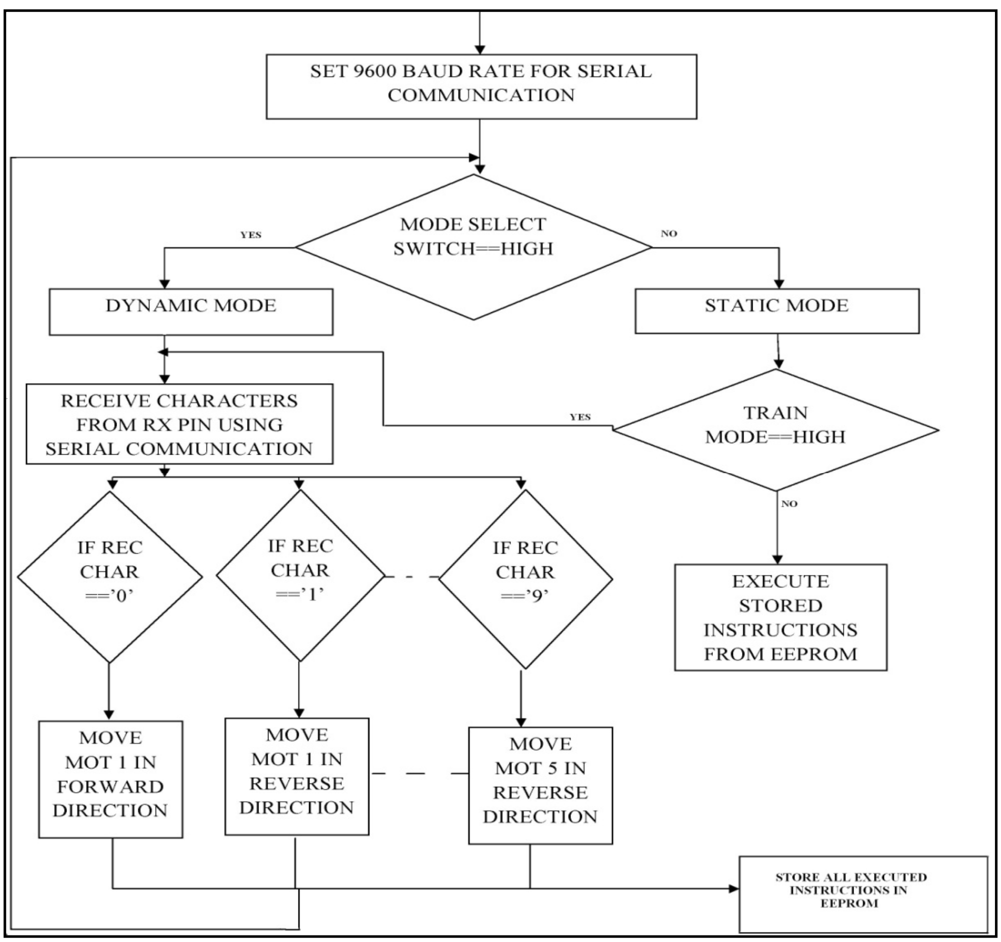

Figure 5: Receiver flow chart

RF communication modules are set at 9600 baud for receiving data. LPC 1768 continuously checks the mode select switch pin if the pin is high, they will operate at the dynamic mode, ie movements system will give the values currently receiving, if no character is received then no movement carried out. If the mode selection switch is LOW, then the system is in static mode, static mode new controller reads the pin rail mode, if this pin is high, then the system enters the training mode where movements performed for the received characters and received characters simultaneously stored EEPROM using I2C protocol. If the train mode pin is low, the system simply executes the instructions that are already stored in EEPROM .

6.Experiments

Our experiments were performed mainly three parts. In first part, we tested the receiver module separately and successfully tested the control of different movements, giving inputs tera terminal (PC). In the second phase the transmitter module is tested by connecting the transmitter output terminal output tera and observed for the different movements of the bending and accelerometer sensors. Next, we tested the complete system without involving tera terminal.

We have also done experiments in dynamic mode and static mode. In the dynamic mode we are able to control the movements of the robotic arm, receiving instructions from accelerometer. In the static mode we trained the system for twenty different movements, and the system runs successfully those twenty movements and continuously.

7.Conclusion & Future Scope

The growing demand for natural and Man Machine Interfaces easy programming platforms robots a gesture recognition system that allows users to control an industrial robot arm was proposed and successfully implemented. A 3-axis accelerometer was selected as the input device of the system, capturing the human arms conduct to control the motion of the robotic arm. And two flexion sensors are used to control the movement of grip. Compared to other common input devices like handheld console, this approach using accelerometers on the wireless medium is easier to work with. Using this system, a programmer can control not an expert robot robot quickly and in a natural way. The low price and short preparation time are other advantages of the system.

Further work be based on increasing the amount of motion accelerometer that is possible through the use of highly sensitive accelerometers. One approach would be the application of a gyroscope in the system, to separate the gravity acceleration due to the inertial acceleration. Using more accelerometers attached to the arms is another possibility.

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