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AVR Microcontroller Based Moving Arm System

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Abstract: Arms are of particular importance as they aid or replace humans in difficult possibly dangerous extravehicular activities. The focus of this thesis is on wireless Arm control. The main aim in our project is to control the movement of the Arm using Hand gesture. Our project is Robotic Arm which is capable of moving three axis viz. x, y, z. It is controlled by wireless remote module built around 'MEMS' sensor. MEMS Accelerometer sensor senses the motion of human hand and gives analog output to the AVR microcontroller. The controller processes the data from the sensor and gives required output to the RF module via SPI bus. RF module transmits radio signals to another RF module present on the arm side which then passes this signal to the Microcontroller for processing. After processing the controller gives commands to actuator which is servo motor in this case. There are total three servos to achieve motion on three dimensional motions.

Index Terms-: Arm, AVR Microcontroller, RF Module.

1.INTRODUCTION

Now a days controlling mechanical actions precisely using electronic brain is very common and the field which deals with, is the 'ROBOTICS'. It is the field which integrates mechanical, electronics, computer, IT and almost every other field on a common platform to have a high performance machine. In practice, it is usually an electro-mechanical machine which is guided by computer or electronic programming, and is thus able to do tasks on its own. Another common characteristic is that by its appearance or movements, a robot often conveys sense that it has intent or agency of its own.

2. LITERATURE SURVEY

ARMs are of particular importance as they aid or replace humans in difficult possibly dangerous extravehicular activities. However, robot intelligence and autonomy are still limited. Therefore, robots need to be supervised or directly teleported in order to accomplish complex tasks in diverse environments. The literature review introduces the reader to, Pick and place Systems, The Main aim in our project is to control the movement of the Arm using Hand gesture. This idea was selected due to the draw backs in the switches used in the legacy systems. The switches contain the debouching error. So we selected some hand movement based systems the accelerometer is used in the different application for sensing X, Y and Z movement. [1]

We have targeted to developed the AVR based ARM for pick and place and video scanning etc. After making survey we have selected the MEMS based accelerometer for sensing the XYZ movement. [2]

3.MODIFICATION

This system includes theRF module for wireless data communication network. This systemalso uses MEMS accelerometer for sensing XYZ movement.
This AVR would be connected to the RF Module transceiver using SPI. The Master part would be connected to the MEMS sensor. The output of sensor is the analog voltage
.A Servo is a small device that has an output shaft. This shaft can be positioned to specific angular positions by sending the servo a coded signal. As long as the coded signal exists on the input line, the servo will maintain the angular position of the shaft.

4. TECHNOLOGY

RF communication works by creating electromagnetic waves at a source and being able to AVR up those electromagnetic waves at a particular destination. These electromagnetic waves travel through the air at near the speed of light. The wavelength of an electromagnetic signal is inversely proportional to the frequency; the higher the frequency, the shorter the wavelengthFrequency is measured in Hertz (cycles per second) and radio frequencies are measured in kilohertz (KHz or thousands of cycles per

second), megahertz (MHz or millions of cycles per second) and gigahertz (GHz or billions of cycles per second). Higher frequencies result in shorter wavelengths. The wavelength for a 900 MHz device is longer than that of a 2.4 GHz device.

5. BLOCK DIAGRAM

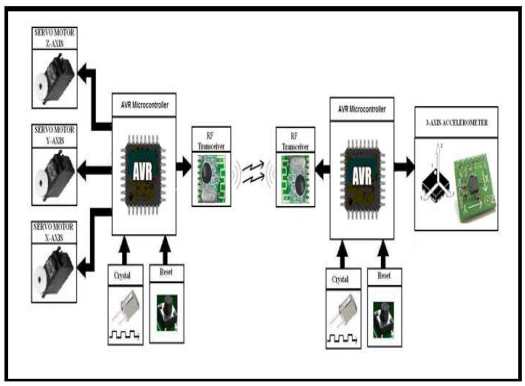

Fig 1. Block diagram of AVR based Moving Arm System

The generalized block diagram of project is shown as above. The block diagram can be divided into two parts first one is Master and second is slave. It consists of following block:-

1. AVR microcontroller
2. RF module
3. Servo motor
4. Reset circuit:
5. MEMS accelerometer

In this project there would be two section master and slave. The slave part would contain the servo motor. The servo motor would be connected to AVR microcontroller.This AVR would be connected to the RF Module transceiver using SPI. The Master part would be connected to the MEMS sensor. The output of sensor is the analog voltage. This analog output would be converted into digital using ADC which is inbuilt in the AVR microcontroller.

The output of ADC is processed and further given to The RF module. This RF module will convert the data in to RFand further it is received by the RF Module connected to the slave part.Depending upon the X, Y or Z movement of the sensor the respective ARM for the X, Y or Z will move. The Crystal will be used for clock frequency Generation. The RC network circuit will be used to generate the power on reset for the microcontroller.

5.1 AVR Microcontroller:

The AVR is a Modified Harvard architecture 8-bitRISC single chip microcontroller (µC) which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage. AVRs have been used in various automotive applications such as security, safety, power train and entertainment systems.Atmel has recently launched a new publication "Atmel Automotive Compilation" to help developers with automotive applications. Some current usages are in BMW, Daimler-Chrysler and TRW. System Semiconductor, Inc. produces the M3000 Motor and Motion Control Chip, incorporating an Atmel AVR Core andAdvanced Motion Controller for use in a variety of motion applications.

1. High-performance, Low-power AVR® 8-bit Microcontroller
2. Advanced RISC Architecture

5.2 Servo Motor

Servomotor: A Servo is a small device that has an output shaft. This shaft can be positioned to specific angular positions by sending the servo a coded signal. As long as the coded signal exists on the input line, the servo will maintain the angular position of the shaft. As the coded signal changes, the angular position of the shaft changes. In practice, servos are used in radio controlled airplanes to position control surfaces like the elevators and rudders. They are also used in radio controlled cars, puppets, and of course, robots.

5.3 RF module

This is an FSK Transceiver module, which is designed using the Chipcon IC (CC2500). It is a true single-chip transceiver, it is based on 3 wire digital serial interface and an entire Phase-Locked Loop (PLL) for precise local oscillator generation .so the frequency could be setting. It can use in UART / NRZ/ Manchester encoding/decoding. It is a high performance and low cost module.
Data rates are usually dictated by the system - how much data must be transferred and how often does the transfer need to take place. Lower data rates, allow the radio module to have better receive sensitivity and thus more range.

Fig.2 RF Module.

5.4 MEMS ACCELEROMETER:

Micro-Electro-MechanicalSystems (MEMS) is the integration of mechanical elements. We found the MEMS technology for the sensor systems. There were three types of the sensor categories based on MEMS. The pressure sensor, accelerometer and gyro.
The accelerometer is used in the different application for sensing X, Y and Z movement.
We have targeted to developed the controlled Arm for pick and place and video scanning etc. After making survey we have selected the MEMS based accelerometer for sensing the XYZ movement.
This sensor is available is small IC form and gives the analog output as per the change in the motion

5.4 RESET CIRCUIT:

A Power-on Reset pulse is generated on-chip whenever VDD rises above a certain threshold. This allows the device to start in the initialized state when VDD is adequate for operation. To take advantage of the POR circuitry, tie the MCLR pin through a resistor (1 kΩ to 10 kΩ) to VDD.

6. EXPERIMENT RESULT

Depending upon the X, Y, Z, movement of the sensor the respective arm will move in Centre position, Rotation movement and Tilt movement as shown in below fig.3, 4 & 5 respectively.

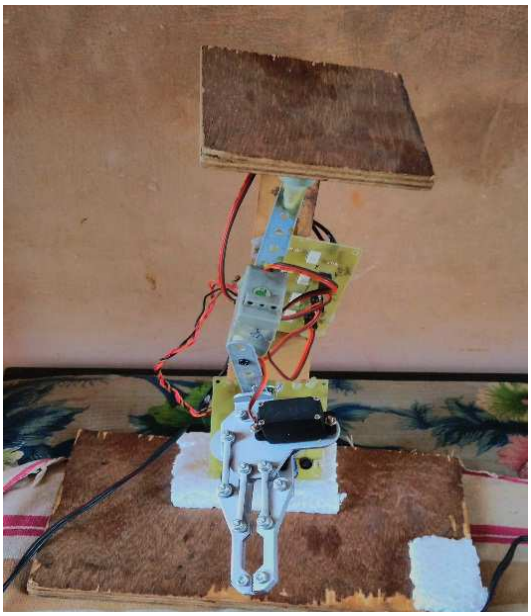

Fig.3 Center Position of the Arm

Fig.4 Rotation Movement of the Arm.

Fig. 5 Tilt Movement of the Arm.

7. APPLICATIONS:-

1. Joystick/ Controller for games
2. Controlling devices in unmanned places.
3. Pointer for conferences
4. Robotic ARM used as a pick and place robot.
5. Accelerometers in modern cars for a large number of purposes including airbag.
6. Bio-MEMS applications in medical and health related technologies.

8. CONCLUSION:-

At the end of our project tenure, we would like to say that this was the most exciting and challenging experience and an important part of our curriculum. This project has certainly helped us in bringing the gap between theory and practical. I understood the scope and job responsibilities which will definitely be beneficial in future.

we have used MEMS MXA2300 as accelerometer. The AVR microcontroller at mega 16 is the heart of the system &it stores & sends data to motors through RF communication.

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