ROBOTIC ARM WITH MEMS TECHNOLOGY

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Abstract: ***The work describes a robustness of MEMS based Gesture Controlled Robot is a kind of robot that can be by our hand gestures rather than an ordinary old switches or keypad. The main aim of this project is to implement 3d print robotic arm by interfacing MEMS technology. Multidimensional motion control of robotic arm mainly use in industry and non-industry purpose. It helps to reduce the human work and increase the precision in work. Robotic arm provide similar function as human arm depending upon the degree of freedom it can offer .For the operation reason, the client application directions are composed programming code by utilizing embedded c. The application system is accumulated by utilizing arduino and proselytes the source record into .hex document .The goal of gesture recognition is to create a system which can identify specific human gestures and use them to convey information or for device control. Real-time vision-based hand gesture recognition is considered to be more and more feasible.***

Keywords – Embedded c, ARDUINO UNO Microcontroller board, MEMS sensor, Robotic Arm.

I. INTRODUCTION

Robotic arm provides similar functions like a human arm depending upon the degree of freedom it can offer. Motion control system plays a major role in the control of different types of industrial automation devices such as robotic arm manipulator [1] Arm controller is the challenging field in industrial applications. Robotic control is an exciting, complex and high challenge research work in recent year [2] The goal of gesture recognition is to create a system which can identify specific human gestures and use them to convey information or for device control[3] The system recognized these gestures with over 97% accuracy[4].

It is a robust way to recognize hand postures and gestures[5]. It can be used to recognize both simple hand postures and gestures and also complex ones as well. and using hand gestures as a control mechanism in virtual reality [6]. It can also be used for the improvement of interaction between two humans.

In our work, a miniature MEMS Accelerometer. Robots are generally used to perform hazardous, highly repetitive, and unpleasant tasks. Most robots are set up for an operation by the teach-and-repeat technique. In this mode, a trained operator (programmer) typically uses a portable control device (a teach pendant) to teach a robot its task manually. The programming and controlling of movements of robotic arm through the use of robot teach pendant is still a difficult and time consuming task that requires technical expertise.

Therefore, new and easier ways for robot programming are required. The main aim of this paper is to develop a methodology with a high level of abstraction that simplifies the robot programming. In this paper we proposed an accelerometer-based gesture recognition system to control an industrial robot in a natural way. A 3-axis wireless accelerometer is attached to the human arm, capturing its behaviour (gestures and postures). A trained system was used to recognize gestures and postures. During the movement controls of any mechanical equipment like robots, robotic arms, the work of miniature accelerometer based recognition system which acknowledges hand gestures or motions will be recognized.

MEMS accelerometer measures the acceleration of the signal in three co-ordinates such as x-axis, y-axis, and z-axis. To capture the hand motions online, the general MEMS sensor which can be operated without any external reference and limitation in working conditions is used. This Arduino Robotic Arm can be controlled by accelerometer attached to it, each accelerometer is used to control each servomotor. You can move these servomotor is based upon the hand movements with holding accelerometer inside, by changing the movements towards up and down the robot works and the by rotating the pots to pick some object, with some practice you can easily pick and move the object from one place to another.

We have used low torque servos here but you can use more powerful servos to pick heavy object works and the robotic arm needs several functions in order to perform the complex tasks. This doesn't give dynamicity to the motion inputs because of layout coordinating. Another framework utilizes machine interface gadget to give continuous signals to the robot. Simplex sensors are utilized on the hand glove to quantify the finger twisting and hand position.

II. PROPOSED METHOD

The proposed machine is an embedded machine so that it will carefully monitor and control the given packages to avoid accidents in Railways. So why no longer we upload a type of intelligence to the train engines itself so that it attempts to avoid injuries. Now a day's public is dealing with many threats from railway department by way of which they are hesitating to plan a train journey. The primary purpose for that is due to the injuries that occur because of negligence of train drivers, though the railway branch is attempting to take actions to reduce such casual matters but couldn't see the face of success. To assist out the department, we've designed our machine. This project is introduced to reveal driving force's condition and to alert him.

Our proposed machine consists of Embedded kit which makes this closed loop feedback control device efficient and reliable. ATMEGA328 Microcontroller allows dynamic and faster manage that's the brain of the circuit as it controls all of the above cited features. To atomize the unmanned railway crossing gate i.e. the gate is closed routinely every time the person comes and is opened after the train leaves the railway-

road crossing for this purpose we use two IR sensor transmitter and receiver pair (Tx-Rx pair) are located at the ends of the gates each on one aspect. Whenever any person is coming on the rail track, the IR sign will be disturbed due to the interruption of the person. Now, after the train had left the crossing, the microcontroller will open the gate by way of rotating the motor. By using Ultrasonic sensors, generate excessive frequency sound waves and examine the echo that is obtained returned by the sensor. Whilst a train meet any impediment with the help of ultrasonic sensor it identifies the impediment at a sure distance and stops from accidents.

By using Fire sensor because of high temperature and any heat extinguish in any of the compartment it could lead to fire twist of fate. So as to overcome that fire sensors are used which are constant in every compartment of the train. If any misuse of fireplace in compartment then the sensor senses it and sends the sign to the driving force inside the form and shows on the liquid crystal display. So the driver detects it and forestalls the fire coincidence with the assist of fireplace sensor.

II. BLOCK DIAGRAM

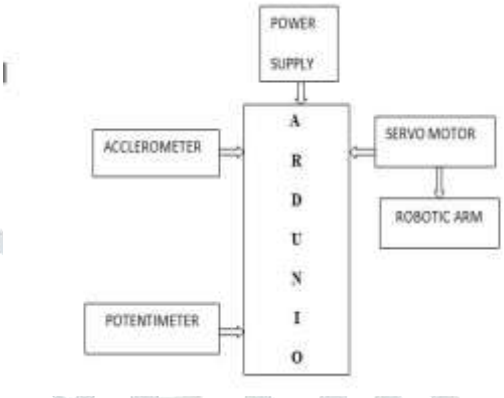

Fig.1.Block diagram of Robotic ARM

III. COMPONENTS USED

A.Arduino board (Microcontroller)

Arduino is an open-source platform used for building electronics projects Arduino consists both a physical programmable circuit board(often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical pins named as GPIO(General purpose input output) pins.

Any microcontroller based board which follows the standard Arduino schematic and is flashed with the Arduino boot loader can be called an Arduino board. The Arduino is referred to as open source hardware, since the standard schematic is open to everyone and anybody can make their own version of Arduino board following the standard schematic. Arduino is a single board microcontroller, intended to make the application of interactive objects or environments more accessible.

The hardware consists of an open source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. Pre-programmed into the on-board microcontroller chip is a boot-loader that allows uploading programs into the microcontroller memory without needing a chip /device programmer. An Arduino microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. This allows an Arduino to be used by novices and experts alike without having to go through the difficulties first faced by many when using electronics by allowing the use of an ordinary computer as the programmer. At a conceptual level, when using the Arduino software stack, all boards are programmed over an RS-232 serial connection, but the way this is implemented varies by hardware version.

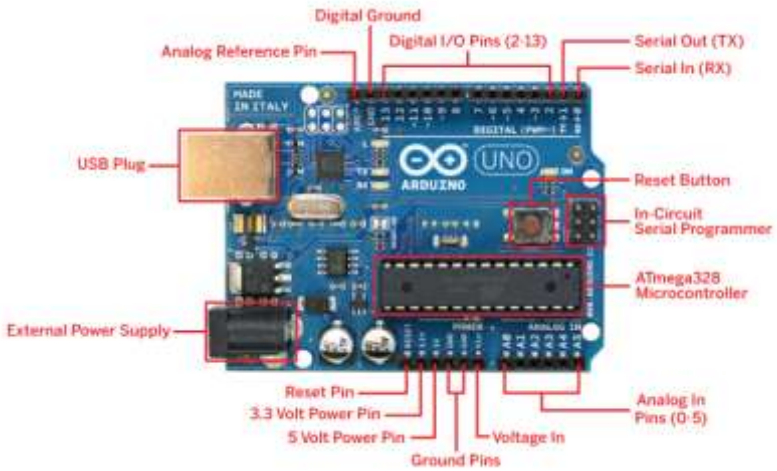

Fig 3.1ARDUINO Board

B.MEMS Accelerometer

Most accelerometers are Micro-Electro-Mechanical Sensors (MEMS). The basic principle of operation behind the MEMS accelerometer is the displacement of a small proof mass etched into the silicon surface of the integrated circuit and suspended by small beams. Consistent with Newton's second law of motion (F = ma), as an acceleration is applied to the device, a force develops which displaces the mass arm.

Accelerometers can be used to effectively translate finger and hand gestures into computer interpreted signals. Integrating a single chip wireless solution with a MEMS accelerometer would yield an autonomous device small enough to apply to the fingernails because of their small size and weight. Accelerometers are attached to the fingertips and back of the hand. Arrows on the hand show the location of accelerometers and their sensitive directions. The sensitive direction of the accelerometer is in the plane of the hand. Micro-electromechanical systems (MEMS) are free scale‘s enabling technology for acceleration and pressure sensors.

MEMS based sensor products provide an interface that can sense, process or control the surrounding environment. MEMS-based sensors are a class of devices that builds very small electrical and mechanical components on a single chip. In this paper, the most recent and main applications of the MEMS technology in the automotive industry are introduced through technology scouting approach. Technology scouting is a powerful tool which contributes to technology management by identifying emerging technologies, and channel technology related information into an organization. First, we classify the general MEMS technologies into 4 classes, and different applications are investigated. Finally, MEMS market in the automotive industry at present and in future is evaluated. Besides, most forecasts suggest that their application in the vehicles will continue to grow to address vehicle safety requirements as well as government mandates.

Furthermore, due to the considerable advantages of such sensors in terms of technical and economic aspects, car engineers continually discover new applications for them so that the safety and efficiency of the vehicles can be enhanced. Now, the manufacturers usually use the MEMS sensors in the vehicle safety parameters. However, the applications related to the performance

Features:

- 3-axis sensing Small,
- low profile package 4 mm × 4 mm × 1.45 mm LFCSP
- Low power : 350 μA (typical)
- Single-supply operation: 1.8 V to 3.6 V 10,000 g shock survival
- Excellent temperature stability BW adjustment with a single capacitor per axis RoHS/WEEE lead-free compliant.

Fig 3.2 MEMS Accelerometer

C.SERVO MOTOR

Servomotors are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor cans usually only turn 90 degrees in either direction for a total of 180 degree movement .Servo motors are very useful in the world of robotics because of its high torque and precise movements [4]. Servomotors work in a closed loop. The closed loop of a servo motor greatly increases the precision of the control system. In a servo motor the angles to which the shaft can turn to is limited only by the number of different PWM pulse widths that the FPGA system can supply.

A servo motor is an automatic device that provides motion control with the help of error-correction. The term ‘servo’ is used for the systems. It means a closed loop feedback mechanism means servo motor used for the position control. It combines AC/ DC motor and position sensor such as digital encoder. In our project we use PWM signal pulses for controlling purpose of the motor at require angle.

Pulse width modulation also known as pulse duration modulation, where samples of the message signal are used to vary the duration of the individual pulses in carrier. But in our case message signal will be the position required for the motor shaft. The term duty cycle describes the proportion of on time to the period of time.

Each motor have different PWM signal as per the motor requirement. PWM signal control the system movements and angles of the robotic arm. Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft. The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated

Fig 3.3 SERVO MOTOR

The motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models. Servomotors are generally used as a high-performance alternative to the stepper motor. Stepper motors have some inherent ability to control position, as they have built-in output steps. This often allows them to be used as an open-loop position control, without any feedback encoder, as their drive signal specifies the number of steps of movement to rotate, but for this the controller needs to 'know' the position of the stepper motor on power up.

Therefore, on first power up, the controller will have to activate the stepper motor and turn it to a known position, e.g. until it activates an end limit switch. This can be observed when switching on an inkjet printer; the controller will move the ink jet carrier to the extreme left and right to establish the end positions. A servomotor will immediately turn to whatever angle the controller instructs it to, regardless of the initial position at power up. The lack of feedback of a stepper motor limits its performance, as the stepper motor can only drive a load that is well within its capacity, otherwise missed steps under load may lead to positioning errors and the system may have to be restarted or recalibrated.

The encoder and controller of a servomotor are an additional cost, but they optimise the performance of the overall system (for all of speed, power and accuracy) relative to the capacity of the basic motor. With larger systems, where a powerful motor represents an increasing proportion of the system cost, servomotors have the advantage.

Specifications:

- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kgf·cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~5V)
- Dead band width: 10 µs
- Temperature range: 0 ºC – 55 ºC

D.ROBOTIC ARM

We use a basic structure of robotic arm which is printed with 3d print and externally connected with tower pro servo which is 180 degree servo technology with that basic aspects to be needed like a control system has to run with at mega 328p which is an open source circuit. A robotic arm is usually programmable, with similar functions to a human arm. The links of such manipulator are connected by joints allowing either rotational motion or translational (linear) displacement.

This robotic arm includes different parameters like weight of each linkage, weight of each joint, weight of object to lift, length of each linkage, degree of freedom, work space 3D printing refers to processes in which material is joined or solidified under computer control to create a three-dimensional object,[1] with material being added together (such as liquid molecules or powder grains being fused together). 3D printing is used in both rapid prototyping and additive manufacturing (AM).

Objects can be of almost any shape or geometry and typically are produced using digital model data from a 3D model or another electronic data source such as an Additive Manufacturing File (AMF) file (usually in sequential layers). Stereo lithography (STL) is one of the most common file types that is used for 3D printing. Thus, unlike material removed from a stock in the conventional machining process, 3D printing or AM builds a three-dimensional object from computer-aided design (CAD) model or AMF file, usually by successively adding material layer by layer.

The term "3D printing" originally referred to a process that deposits a binder material onto a powder bed with inkjet printer heads layer by layer. More recently, the term is being used in popular vernacular to encompass a wider variety of additive manufacturing techniques. United States and global technical standards use the official term additive manufacturing for this broader sense, since the final goal of additive manufacturing is to achieve mass-production, which greatly differs from 3D printing for Rapid prototyping.

Fig 3.4 ROBOTIC ARM

Specifications:

Repeatability (mm): Repeatability refers to the ability of the robot arm to return to a previous point. Many current industrial robot arms feature repeatability of +/- 0.5 millimetres to +/- 0.02 millimetres. Other industrial robot specifications are important to consider when selecting an industrial robot arm.

IV METHODOLOGY

This is an automatic closed loop control system. Here instead of controlling a device by applying the variable input signal, the device is controlled by a feedback signal generated by comparing output signal and the reference input signal. When reference input signal or command signal is applied to the system, it is compared with output reference signal of the system produced by output sensor, and a third signal produced by a feedback system.

A servo (servomechanism) is an electromagnetic device that converts electricity into precise controlled motion by use of negative feedback mechanisms. servos can be used to generate linear or circular motion, depending on their type. The makeup of a typical servo includes a DC motor, a gear train, a potentiometer, an integrated circuit (IC) and an output shaft. The desired servo position is input and comes in as a coded signal to the IC.

The IC directs the motor to go, driving the motor's energy through gears that set the speed and desired direction of movement until the signal from the potentiometer provides feedback that the desire position is reached and the IC stops the motor. The potentiometer makes controlled motion possible by relaying the current position while allowing for correction from outside forces acting on control surfaces: Once the surface is moved the potentiometer provides the signal of position and the IC signals the necessary motor movement until the correct position is regained.

A combination of servos and multi-geared electric motors can be organized together to perform more complex tasks in various types of systems including robots, vehicles, manufacturing and wireless sensor and actuator network .

Position control:

Globe control valve with pneumatic actuator and "positioner". This is a servo which ensures the valve opens to the desired position regardless of friction A common type of servo provides position control. Commonly, servos are electrical, hydraulic or pneumatic. They operate on the principle of negative feedback, where the control input is compared to the actual position of the mechanical system as measured by some sort of transducer at the output. Any difference between the actual and wanted values (an "error signal") is amplified (and converted) and used to drive the system in the direction necessary to reduce or eliminate the error. This procedure is one widely used application of control theory. Typical servos can give a rotary (angular) or linear output.

Speed control:

speed control via a governor is another type of servomechanism. The steam engine uses mechanical governors; another early application was to govern the speed of water wheels. Prior to World War II the constant speed propeller was developed to control engine speed for manoeuvring aircraft. Fuel controls for gas turbine engines employ either hydro mechanical or electronic governing**.**

V PROJECT RESULT

FIG 5.1 AURDUINO BOARD

FIG 5.2 ROBOTIC ARM

FIG 5.3 HAND GUESTURES

VIII. CONCLUSION

In our arrangement of Motion Controlled we have just consider a predetermined signals. the speed control of robotic arm can be achieved by changing the frequency of pwm signal for motor on every joint.The mechanical arm will copy the development of the controller. Progressed mechanical arms like these can many many charger perform unpredictable and perilous errands easily. Proposed utility in fields of development, perilous waste transfer, and therapeutic sciences.

ACKNOWLEDGEMENT

I would like to acknowledge Control Sytems Lab for providing me the opportunity to carry out the project of Gesture Controlled Robot at ANITS College, Andhra university also like to give thanks to B.RajaSekhar under whom I have completed my project. I would express my thanks to Varada,Raju, M.Tech Electronics, Raghu Engineering College, jntuk university, who helped me a lot in carrying out this project.

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