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Design and Implementation of Wireless Robotic Arm Model using Flex and Gyro Sensor

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Abstract : In this day and age there is an expanding need to make artificial arms for different inhuman situations where human communication is troublesome or inconceivable. They may include taking readings from a functioning spring of gushing lava to diffusing a bomb. Here we propose to assemble a mechanical arm constrained by characteristic human arm developments whose information is procured using accelerometers. For appropriate control instrument and to lessen the measure of commotion rolling in from the sensors, legitimate averaging calculation is utilized for smoothening the yield of the accelerometer. The advancement of this arm depends on Arduino ATmega328 and which will all be interfaced with one another utilizing sequential correspondence. The automated arm structured here has six positions like both ways revolution, arm open and close, 90 and 180 degree tendencies working at 433Hz and can pick 150gms of weight . At last, the structured arm model pictures alongside table containing particulars is featured in results that might be required to conquer the issue, for example, putting or picking risky articles or non-dangerous items that are far away from the client.

Keywords- Arduino ATmega328, Flex sensor, Gyro sensor, Servo motor.

I. INTRODUCTION

These days, robots are progressively being coordinated into working errands to supplant people particularly to play out the dull assignment. By and large, apply autonomy can be partitioned into two zones, mechanical and administration apply autonomy. International Federation of Robotics (IFR) characterizes an assistance robot as a robot which works semi-or completely self-governing to perform administrations helpful to the prosperity of people and gear, barring fabricating tasks. These robots are right now utilized in numerous fields of utilizations including office, military undertakings, emergency clinic activities, perilous condition and agribusiness.

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Additionally, it may be troublesome or risky for people to do some particular assignments like getting unstable synthetic substances, defusing bombs or in most dire outcome imaginable to pick and place the bomb some place for regulation and for rehashed pick and spot activity in ventures. In this way a robot can be supplanted human to do work.

The principle motivation behind this exploration is to present a gadget for association among human and personal computer. Especially, Arduino glove is proposed in this paper to recognize the free developments of hand and fingers which could be utilized as a contribution for different frameworks .As the key segment of this examination, the toy vehicle is utilized; be that as it may, some other gadget, for example, robot arms, helicopters, quad copters just as other intelligent gadgets could be utilized. The contribution of the framework is constrained by the sensors which are spoken to by flex sensor and is utilized to catch mixing point of a finger. The gyro sensor is utilized to catch hand pivot.

In this paper, firstly contains section 1 gives the introduction of robotic arm, secondly section2 reveals about literature review , thirdly section3 describes the problem statement, fourthly section4 contains the technical requirements needed, fifthly section5 portrays about research methodology, lastly section6 discusses about results, conclusion and future enhancement.

1.1 Robotic arm definition

An automated arm is a robot controller, normally programmable, with comparative capacities to a human arm. The connections of such a controller are associated by joints permitting either rotational movement, (for example, in an enunciated robot) or translational (direct) dislodging. The connections of the controller can be considered to shape a kinematic chain. The business end of the kinematic chain of the controller is known as the end effectors and it is practically equivalent to the human hand. The end effectors can be intended to play out any ideal undertaking, for example, welding, holding, turning and so forth., contingent upon the application. The robot arms can be self-ruling or controlled physically and can be utilized to play out an assortment of assignments with incredible exactness. The automated arm can be fixed or versatile (for example haggled) be intended for mechanical or home applications. This report manages an automated arm whose goal is to copy the developments of a human arm utilizing accelerometers as sensors for the information securing of the common arm developments. This strategy for control permits more prominent adaptability in controlling the automated arm as opposed to utilizing a 2 controller where every actuator is controlled independently.

The handling unit deals with every actuator's control signal as per the contributions from accelerometer, so as to duplicate the developments of the human arm.

II. LITERATURE REVIEW

2.1 Kadirimangalam Jahnavi's paper comprises of OWI automated arm with 5-Degrees Of Freedom (DOF) with DC engines for each joint development, Arduino based control unit for control of arm movement and a MATLAB based Graphical User Interface (GUI) with kinematics calculation at the backend giving easy to use condition to controlling the end effector of robot arm remotely. The automated arm is furnished with accelerometers to give criticism to the microcontroller. The kinematics calculation is actualized in MATLAB. The MATLAB based GUI, Arduino controller and accelerometers together with the automated arm give the down to earth research center model of showing learning mechanical arm stage [2]. This robot arm likewise gives remain solitary activity to pick and place application with the utilization of Arduino controller and accelerometers.
2.2 Virendra Patidar's work makes upgrades over the current strategies by planning an automated arm with 7 DOF (Degree of Freedom), and afterward begins working at arm envelope, space and expanding its effectiveness [3]. At long last, we include grasp, hold and spot ability utilizing various calculations and reenactment. The proposed methodology including an automated arm with 7 DOF outflanks the customary strategies for structuring a mechanical arm.

2.3 Tejas has planned a mechanical arm, which will be introduced where an individual has lost his arm. Presently, utilizing his other arm, which is as yet flawless, the activities of the automated arm is controlled. The thought is to copy every one of the activities of the human arm. It is worked on a remote stage, in this manner taking out wires running on the body [4].

2.4 Ms. Puja Dhepekar proposes remote controlled mechanical framework for careful device taking care of (pick and spot). In this, we utilize three unique fingers position of hand to control the mechanical framework with the assistance of flex sensor development [5]. As indicated by various places of the finger, obstruction of the flex sensor changes, this adjustment in the opposition is utilized to move the pole of servo engine that moves the automated arm according to position of a flex sensor in remote condition utilizing Zigbee gadget.

2.5 Toshika gives an approach to dispose of antiquated remote controls and gives a natural procedure for execution of Semi Humanoid Gesture controlled robot. The movement sensors utilized are - flex and accelerometer (utilized in cell phones for tilting movement). It incorporates two mechanical arms which are actually like human arms (with 5 fingers), expanding affectability of the framework, a moving stage and a camera for catching continuous video. The prime point of the framework is to plan a framework so that client can work the robot without breaking a sweat through motions [6]. This includes development of both automated arms and stage in synchronous with client's hand and leg motions individually.

III. PROBLEM STATEMENT

By and large by far most of the mechanized arms are compelled by a central controller which makes businesses of characteristics taken in from the terminal that are entered by the customer at the terminal to move the arm to a particular composes in space. This makes the control problematic as the control estimations of the motors are uncommonly difficult to anticipate to achieve a particular improvement. This is successfully practiced by our paper. This paper addresses an essential Flex sensor and Gyro sensor which fixed to glove and its controlled robotized arm using Arduino Atmega328 filled embedded structure as the focal point of this robot .The robot doesn't require getting ready considering the way that the mechanical arm is totally compelled by the customer. This interfacing is done using remote correspondence through radio frequency transmitter and Receiver.

IV. TECHNICAL REQUIREMENTS

1. ATmega328-ATMega328 microcontroller is an ATMEL 8-piece microcontroller with 32Kb in-framework programmable glimmer. It has superior and has a place with low power Atmel 8-piece microcontroller family. ATMega328 controller has a propelled RISC design with 131 incredible directions in which a large portion of the guidelines are single clock cycle execution. It has 32x8 universally useful working registers and 20 MIPS throughput at 20MHz Some exceptional microcontroller highlights are it has programmable darker out recognition circuit and power on reset, inside adjusted oscillator, interior and outer interfere with sources and 6 rest modes (shut down, commotion decrease in ADC, broadened backup, reserve, inactive and control spare). It has 23 programmable I/O lines[7]. It works at the temperature – 40 ^{0}C to 85 ^{0}C. Speed evaluation of the microcontroller is 0-20MHz at 4.5V to 5.5V

A portion of the fringe highlights of ATMega328 microcontroller are :

- 10 bit ADC with 6 divert in PDIP bundle ,
- Separate oscillator with constant counter ,
- On-chip simple comparator ,
- Wakeup on pin change and hinder ,
- Two 8-piece clock

2. RF transmitter and recipient (433Mhz) - This circuit uses the RF module (Tx/Rx) for making a remote, which could be utilized to drive a yield from a far off spot. RF module, as the name proposes, utilizes radio recurrence to send signals. These sign are transmitted at a specific recurrence and a baud rate. A collector can get these sign just in the event that it is designed for that recurrence.
3.Voltage regulator-LM78XX/LM78XXA-Three-Terminal 1A Positive Voltage Regulator .It can give upto Output Current up to 1A , Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24 , Thermal Overload Protection, Short Circuit Protection. The LM78XX arrangement of three terminal positive controllers are accessible in the TO-220 bundle and with a few fixed yield voltages, making them valuable in a wide scope of utilizations.

Each type utilizes interior current restricting, warm shut down and safe working zone insurance, making it basically indestructible. On the off chance that sufficient warmth sinking is given, they can convey over 1A yield current. Albeit planned essentially as fixed voltage controllers, these gadgets can be utilized with outside segments to acquire flexible voltages and flows.

4. Engine driver(L293D) - The L293D engine driver is accessible for giving User straightforwardness and easy to use interfacing for installed application. L293D engine driver is mounted on a decent quality, single sided non-PTH PCB. The pins of L293D engine driver IC are associated with connectors for simple access to the driver IC's pin capacities. The L293D is a Dual Full Bridge driver that can drive up to 1Amp per connect with supply voltage up to 24V. It can drive two DC engines, transfers, solenoids, and so on. The gadget is TTL good. Two H scaffolds of L293D can be associated in parallel to expand its present ability to 2 Amp. Highlights incorporates Easily good with any of the framework , easy interfacing through FRC (Flat Ribbon Cable) , External Power supply pin for Motors bolstered, Onboard PWM (Pulse Width Modulation) choice switch , 2pin Terminal Block (Phoenix Connectors) for simple Motors Connection

5. Flex sensor - The Flex Sensor licensed innovation depends on resistive carbon components. As a variable printed resistor, the Flex Sensor accomplishes incredible structure factor on a dainty adaptable substrate [8]. At the point when the substrate is twisted, the sensor delivers an obstruction yield related to the twist span—the littler the sweep, the higher the opposition esteem. Spectra Symbol has utilized this innovation in providing Flex Sensors for the Nintendo Power Glove, the P5 gaming glove. Fig.1. Picturizes the flex sensor for various tendencies.

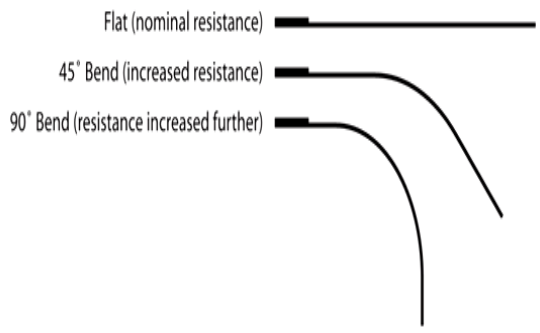

Fig.1. Picturizes the flex sensor for different inclinations

6. Gyro sensor - IMU sensors are one of the most unavoidable sort of sensors utilized today in a wide range of electronic devices. They are seen in cell phones, wearables, game controllers, and so on. IMU sensors help us in getting the mentality of an article, appended to the sensor in three dimensional space. These qualities for the most part in points, therefore help us to decide its frame of mind. Hence, they are utilized in cell phones to identify its direction. IMU (Inertia Measurement Unit) sensors, perfect with arduino. It ready to work with the two accelerometers and gyrators independently. Be that as it may, they are not as precise as when they are consolidated. Also, among the parcel, I saw the MPU 6050 as the most dependable and precise IMU sensor. Aside from being essentially modest from different sensors, the MPU 6050 performs much better as well. Fig.2. shows the gyrosensor pin setup.

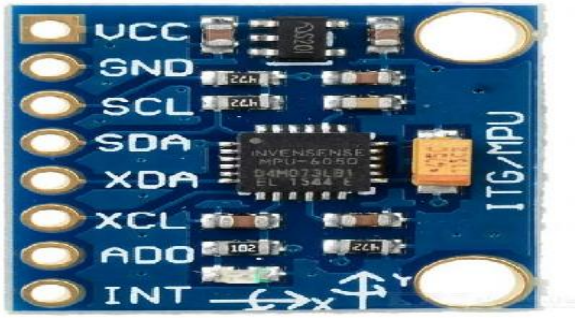

Fig. 2. shows the gyrosensor pin setup

7. Robotic arm-A mechanical arm is a robot controller, normally programmable, with comparable capacities to a human arm. The connections of such a controller are associated by joints permitting either rotational movement, (for example, in a verbalized robot) or translational (direct) uprooting. The connections of the controller can be considered to shape a kinematic chain. The business end of the kinematic chain of the controller is known as the end effectors and it is similar to the human hand. The end effectors can be intended to play out any ideal errand, for example, welding, holding, turning and so forth., contingent upon the application. The robot arms can be self-governing or controlled physically and can be utilized to play out an assortment of errands with incredible exactness. What's more, can be intended for mechanical or home applications. This paper manages an automated arm whose goal is to emulate the developments of a human arm utilizing [9] Flex sensors and gyro sensor as sensors for the information securing of the common arm developments. This strategy for control permits more noteworthy adaptability in controlling the mechanical arm . The handling unit deals with every actuator's control signal as indicated by the contributions from sensors , so as to repeat the developments of the human arm Fig.3. Shows the Robotic arm.

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8. Servo engine :Servo engines are a kind of electromechanical actuators that don't turn ceaselessly like DC/AC or stepper engines; rather, they are utilized to position and hold some article.

They are utilized where consistent pivot isn't required so they are not used to drive wheels (except if a servo is adjusted). Conversely they are utilized where something is expected to move to specific position and afterward halted and hold there. Most regular use is to situate the rudder of airplanes and pontoons and so forth. The servo can be told to turn to a specific edge (say 30) and afterward hold its situation there. Servos additionally utilize an input system, so it can detect a blunder in its situating and right it. This is called servomechanism. State on the off chance that you request that servo proceed to bolt itself to 30 degrees and afterward attempt to turn it with your hand, the servo will make a decent attempt and its best to beat the power and keep servo secured its predetermined point. Controlling a servo is simple by utilizing a microcontroller, no outside driver like h-connect and so forth are required. Only a control signal is should have been feed to the servo to situate it in any predefined point. The recurrence of the control signal is 50 Hz (for example the period is 20ms) and the width of positive heartbeat controls the point. We can utilize the AVR microcontrollers PWM highlight to control servo engines. Along these lines the PWM with consequently create sign to bolt servo and the CPU is allowed to do different assignments.

9. DC Motor - DC Geared Motor, 12V, 10 RPM, Torque up to 5 Kg-cm : This DC Motor with Metal Gear Head is perfect for low RPM, High Torque application like lifting an article through Hook and furthermore valuable for different mechanical autonomy applications. This Motor has following electrical and mechanical particulars.

V. RESEARCH METHODOLOGY

IMU sensors normally comprises of at least two sections. Posting them by need, they incorporate accelerometer, whirligig, magnetometer and altimeter. The MPU 6050 is a six DOF (Degrees of Freedom) or a six hub IMU sensor, which implies that it gives six qualities as yield. Three qualities from the accelerometer and three from the spinner. The MPU 6050 is a sensor dependent on MEMS innovation. Both the accelerometer and the spinner is inserted inside a solitary chip. This chip utilizes I2C (Inter Integrated Circuit) convention for correspondence. The sign from the arduino arm having flex sensor with gyro sensor working at 433hz is sent to ATmega328 [10],later that is transmitted to recieving wire through remote channel. Fig.4. shows the block diagram of proposed transmitter framework.

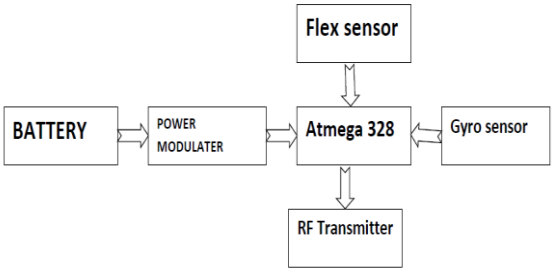

Fig .4.Shows the block diagram of proposed transmitter system.

At the less than desirable end RF collector gets the sign and that is sent to atmega328 arduino for further preparing. The mechanical arm can act as per human arm motions and can pick and drop about 150gms of weight. Fig.5. .Shows the square graph of proposed receiver framework.

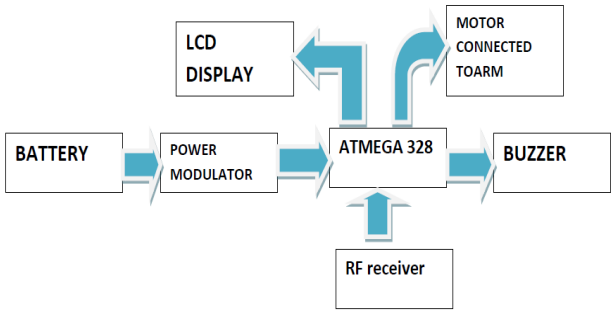

Fig.5. Shows the block diagram of receiver system.

5.1 Hardware Implementation

Flex sensor which is fixed on our fingers interfaced with arduino when collapsed faculties the sign and Gyro sensor detected sign are sent to recipient through RF transmitter as appeared in Fig.6. speaks to Flowchart of transmitter.

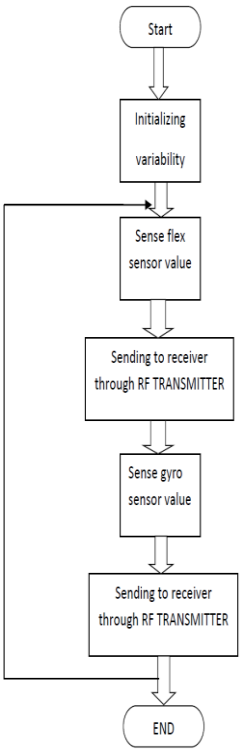

Fig.6. Represents Flowchart of transmitter.

RF collector gets the sign from transmitter and that causes servo engine put in finger and wrist of robot arm to move. Whenever changed detected information is sent from flex sensor and gyro sensor automated arm adjusts in like manner to the transmitted information with minor deferral. Fig.7. speaks to the Flowchart of receiver.

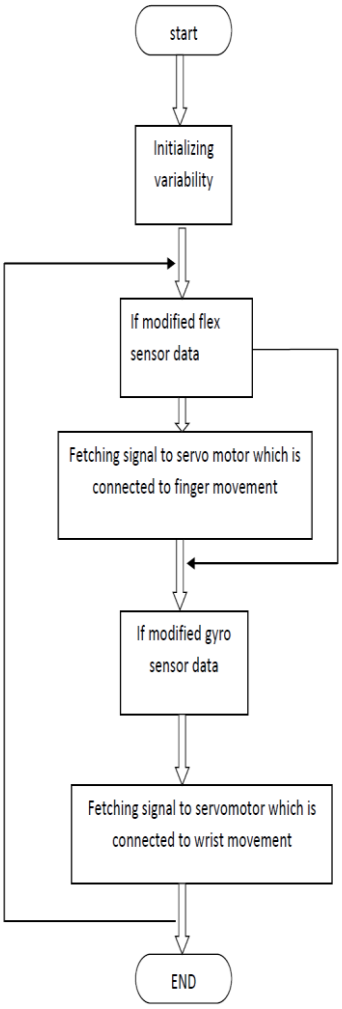

Fig.7. Represents the Flowchart of receiver.

5.2 Software Requirements

Programming prerequisites incorporates arduino programming and programming in embedded C. With the assistance of Arduino board intelligent items can be created by, taking the contributions from sensors and switches, and controlling assortment of physical yields. The Arduino is for the most part favored in light of the fact that it is reasonable, basic programming condition, cross stage and it is open source and programming and equipment can be expanded.

VI. RESULTS

Arduino ATmega328 appended to human arm containing flex sensor and gyro sensor detects the finger collapsing and turns of human arm and is transmitted to beneficiary arduino which at that point forms the sign and that controls the servo motor put in robotic arm working at 433hz and can convey a load of 150gms. We can observe 6 different positions of robotic arm like right, left, open, close, 90^0 and 180^0 inclinations as shown in the Fig.8. Six different positions of Robotic arm.

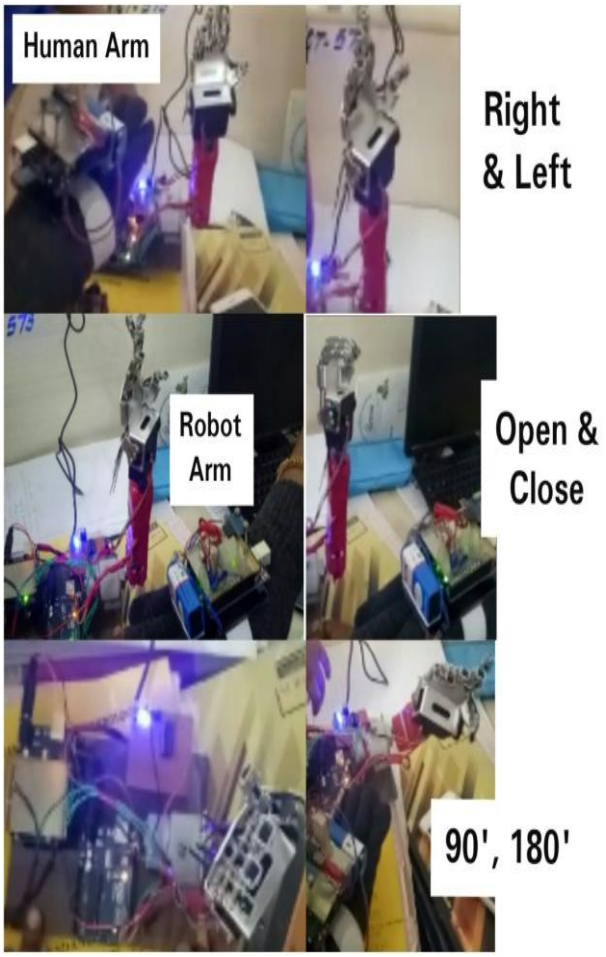

Fig.8. Six different positions of Robotic arm.

Table-I: Specific features used for Robotic arm.

Parameter	Specific Value
Engine Type	DC with gear box metal apparatuses.
Base engine	DC 3000 RPM
Type of shaft	circular 6mm Diameter containing inside gap for coupling 23mm length of shaft
Most extreme Torque	4kg-cm at 12v
RPM	10 Rpm at 12v
Weight	150gms.
Frequency	433Hz
Six operations	Right and left, open and close, Arm up and down
Sensor used	Flex, Gyro and servo motor

Table- II: List of Acronyms

Acronym	Full form
IFR	International Federation of Robotics
DOF	Degree of Freedom
GUI	Graphical User Interface
ATMEL	Advanced Technology for Memory and Logic
RISC	Reduced Instruction set computer
ADC	Amalog to Digital convertor
TTL	Transistor Transistor Logic
FRC	Flat Ribbon Cable
PWM	Pulse Width Modulation
IMU	Inertia Measurement Unit
MEMS	Micro Electro Mechanical Systems
I2C	Inter Integrated circuit
RPM	Rotation Per Minute

VII. CONCLUSION

The targets of this paper has been accomplished which was building up the equipment and programming for a flex sensor and gyro sensor controlled mechanical arm. From perception that has been made, it unmistakably shows that its development is exact, precise, and is anything but difficult to control and easy to use to utilize .The paper is based on a remote transmission, here we transmit and get the sign with out yonder range between 9 to 10 meters since RF Trans and recipient we use for demo reason, and here we utilize automated arm that is made for small scale weight lift, And here we do the 6 activities, for example, arm left and right, fingers open and close, hand here and there.. This mechanical arm control strategy is relied upon to beat the issue, for example, setting or picking object that away from the client, pick and spot risky item in a quick and simple way.

FUTURE SCOPE

More weight can be lifted contrast with human. Numerous activities should be possible in each deliver turn. In the event that individual is physically crippled can likewise work like typical people by utilizing this hand glove method. It tends to be utilized in modern applications with the goal that labor can be reduced. Here one flex sensor is utilized to crease the finger, in future we can utilize 5 flex sensors and extra gyro sensors and engines for mechanical application to build the limit of hardware for future upgrade.

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