

Analytical Study on the Gesture Control of Arduino Robot

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Abstract - Gesture managed a car is a form of robotics that may be controlled with the aid of simple human gestures. The person just needs to wear a gesture tool wherein a sensor is included. The sensor will record the movement of a hand in a particular path if you want to result in the motion of the robotic within the respective guidelines. The robotic and the gesture tool are related wirelessly thru radio waves. Users can engage with the robot in a greater pleasant way because of the Wi-fi verbal exchange. We are able to manipulate the auto usage of accelerometer sensors connected to a hand glove. The sensors are intended to replace the remote manage this is commonly used to run the automobile. It will permit the person to control the ahead, backward, leftward, and rightward movements, while the use of the same accelerometer sensor to manipulate the throttle of the automobile. The movement of an automobile is managed by means of the differential mechanism. The mechanism involves the rotation of both forth & rear wheels of the left or right facet to move inside the anticlockwise path and the other pair to rotate inside the clockwise course which makes the auto-rotate about its very own axis with none form of ahead or backward movement. The main gain of this mechanism is the car with this mechanism can take sharp flips with no difficulty. A flex sensor is proposed for the design and implementation of a gesture control robotic arm. The robot arm is made to imitate the human hand movements the use of a hand glove.

Index Terms - Robot arm, flex sensor, wireless module, accelerometer.

1.INTRODUCTION

Nowadays, robotics is getting one of the maximum superiors in the discipline of an era. A robotic is an electro-mechanical system this is operated through a pc program. Robots may be autonomous or semi-self-reliant. An independent robot isn't controlled by

humans and acts on its personal decision by sensing its surroundings. The majority of industrial robots are self-sustaining as they are required to perform at high velocity and with awesome accuracy. But some programs require semi-self-sustaining or human-controlled robots. Some of the most generally used manipulate systems are voice popularity, tactile or touch-controlled and motion managed. A gesture-controlled robotic is a kind of robotic that may be controlled via your hand gestures no longer with the aid of antique buttons. You simply want to put on a small transmitting device in your hand which protected an acceleration meter. This can transmit the perfect command to the robotic so that it could do something we want. The transmitting device blanketed an analog to digital converter for analog to virtual conversion and an encoder ic(ht12e) which is found to encode the 4-bit statistics after which it's going to transmit via an rf transmitter module. On the receiving cease an rf receiver module obtains the encoded information and decodes it by using and decoder ic(ht12d). This fact is then processed by using a microcontroller and eventually our motor motive force to control the motors. Now it's time to interrupt the task in distinctive modules to make the task easy and simple any assignment becomes clean or mistakes-free if it's far finished in distinctive modules. As our task is already divided into distinct elements transmitter and receiver. The applications of robotics, in particular, contain in automobiles, clinical, creation, protection and extensively utilized as a hearth fighting robot to help the people from the fire twist of fate. But, controlling the robotic with a faraway or a switch is pretty complex. So, a new challenge is evolved this is, an accelerometer-based gesture manipulation robot. The primary purpose of this task is to govern the

motion of the robotic with hand gestures the usage of an accelerometer. The robot is usually an electro-mechanical device that can perform responsibilities automatically. Some robots require some diploma of steering, which can be executed using a remote control or with a pc interface. Robots may be self-reliant, semi-autonomous, or remotely controlled. Robots have developed so much and are able to mimic human beings that they seem to have thoughts in their personal.

1.1 Problem statement

The conventional wired buttons managed robotically will become very bulky and it also limits the distance the robotic goes. The wireless hand-managed robotic will feature by using a wearable hand glove from which the moves of the hand can be used as the input for the motion of the robotic. The primary concept of our undertaking is to expand a system (robot) that could understand the human interplay with it to accomplish the certain duties assigned to it. In our challenge, we can layout a wearable hand glove with the intention to contain the sensors mounted on it to capture the motion of the hand and convert the uncooked mechanical facts into electrical form. These statistics might be further processed and transformed into an understandable format for the lilypad set up on the glove. This lilypad will act as a transmitter of the data for wireless communication motive. Once the transmitted information is acquired via the receiver module in an effort to be linked to the microcontroller, it is going to be processed and further despatched to the microcontroller. The microcontroller will deduce the instructions and therefore it's going to actuate the motor drivers to govern the motors for diverse responsibilities on the robotic.

1.2. Objectives

The goal of the task is to increase a human gadget interface used for the control robot arm. Our objective is to make this tool simple as well as reasonably priced so it is able to be produced and used for several functions. The goal of this venture is to build an automobile that may be controlled by using gestures wirelessly. In this mission, the person is likewise able to control the motions of the automobile by way of wearing a controller glove and acting predefined gestures. This will be extensively utilized in lots of

potential applications which include wi-fi controller car racing and so forth.

1.3. Scope

- Wi-fi-managed robots are very beneficial in many packages like remote surveillance, army, and many others.
- Hand gesture-controlled robotic may be utilized by bodily challenged in wheelchairs.
- Hand gesture-controlled industrial-grade robotic palms may be advanced.
- Entertainment programs – Maximum videogames today are played either on recreation consoles, arcade gadgets, or computers, and all require a combination of entering gadgets. Gesture recognition may be used to truly immerse gamers in the game world like in no way before.
- Automation systems –In homes, workplaces, transport cars, and more, gesture recognition can be integrated to greatly grow usability and reduce the resources essential to create number one or secondary input systems like remote controls, vehicle entertainment systems with buttons, or similar.
- Less complicated life for the disabled – considered one of the most important demanding situations faced today is supplying separate and similarly non-cumbersome services to the in a different way abled and handicapped. Whilst there are unique provisions around the world, there's nonetheless massive room for development to bring all lives on the same footing. Gesture recognition technology can eliminate lots of guide labor and make lifestyles a great deal less complicated for folks that aren't as fortunate as most people are.

These are just a handful of the places and situations wherein gesture recognition generation may be implemented, and as is evident, can completely change the manner we engage with the arena around us, now not handiest at domestic, but in commercial venues as well. In truth, a South African corporation had come up with a progressive gadget placed on the Tambo worldwide airport that detected visitors who yawned or regarded sleepy and allotted unfastened cups of coffee. Even though it used only primary facial and gesture reputation era, it's far though an exciting investigate what can be completed with this

technology. Presently, there aren't too many gesture recognition programs available for public use, but, in spite of its ability for actual international packages, gesture popularity generation is sincerely ruled by using the videogame industry. Electronics giants Microsoft and Sony, makers of the Xbox and PS line of consoles respectively, have incorporated gesture recognition to an extent into their amusement systems, thru more hardware. Known as 'Kinect inside the case of Microsoft and the 'ps eye/digicam' inside the case of Sony, these notable gadgets deliver us one step closer to the future. Whilst Microsoft in 2014 has long passed ahead and blanketed the Kinect 2. Zero digicams with the Xbox one, their contemporary gaming console and made gesture and voice manipulate an essential part of it, Sony has left the digicam as an accent for the PlayStation 4, as an alternative specializing in conventional input strategies.

To date, you came to recognize approximately hand gesture managed robotic that absolutely actions in line with moments of your hand (signal of input to the tool).

1.4. Methodology

Methodology for communication signal

Transmitter Module

An RF transmitter module is a small PCIE, revealed circuit board sub-meeting able to transmitting a radio wave and modulating that wave to hold statistics. Transmitter modules are generally carried out along a microcontroller so that you can offer data to the module that's transmitted. RF transmitters are a common concern to regulatory requirements which dictate the maximum allowable transmitter strength output, harmonics, and band area requirement.

Receiver modules

An RF receiver module rf433-Rx is 433 MHz radio receiver gets the modulated RF sign, after which it demodulates. There are sorts of RF receiver modules. First, rate-regenerative modules are common of low cost and low strength designs the use of a series of amplifiers use to extract modulated data from a carrier wave. Superb-regenerative modules are commonly imprecise as their frequency of operation varies in an honest amount with temperature and energy deliver voltage. Splendid heterodyne receivers having a performance benefit over extraordinary-regenerative;

they offer multiplied accuracy and balance over a large voltage and temperature variety. This stability comes from a set crystal design which in flip ends in a comparatively extra high-priced product. Radio receiver which receives the transmitted coded from the far-flung vicinity these codes are transformed to digital layout and output is to be had to the pin No 2 of the ic2 grasp microcontroller; this is the pin of inbuilt artwork of the microcontroller. Master will give a command to slave microcontroller which is completely based on input code and robot will behave as follows.

- Actions in the forward direction
- Actions in the opposite direction
- Speed controls in both the course
- It can even turn left or proper while shifting ahead or in reverse route.
- In case of bump moves reverse turn left or right and wait for the next coaching.
- Instantaneous left or right flip to skip through the slender area
- We've additionally added headlight, returned mild, and turning lighting fixtures to left a right.

Methodology for Motion Control

L293d is a twin h-bridge motor driving force incorporated circuit (ic). Motor drivers act as contemporary amplifiers as they take a low-modern-day control sign and offer a higher-present day signal. This better cutting-edge sign is used to power the motors. L293d includes two built-in h-bridge motive force circuits. In a common mode of operation, two dc motors may be driven simultaneously, both in ahead and opposite routes. The motor operations of two motors can be managed via input common sense. When an enable input is excessive, the associated driving force receives enabled. As an end result, the outputs emerge as live and work in a segment with their inputs. In addition, whilst the enable enter is low, that driving force is disabled, and their outputs are off and in the high-impedance state. This undertaking controls a faraway robotic through rf. The everyday 433 MHz RF modules are used on this mission. At89c51 microcontroller is used in this assignment. This robotic can carry out its operations without direct human steerage. They're used basically for business applications and can be made laser-guided. Navigation is executed by means of one of the several means,

which include following a direction defined by buried inductive wires, floor-mounted magnetic or optical strips; or instead by means of the manner of laser steering. This is a stepped forward model of my preceding robotic which we designed years ago. Smart spy robot venture has been designed for the spying reason. It's far radio controlled and may be operated at a radial distance of 100m radius. Maximum in all likelihood our army teenagers want to challenge into the enemy area just to music their activities.

Which is mostly a very risky task and may cost treasured lifestyles? Such a dangerous job might be done by the usage of small spy robots all of the evolved and strengthen countries are in the system of making it, a robot that can combat in opposition to the enemy.

This robot is radio operated which is, self-powered, and has all the controls like an ordinary car. A laser gun has been mounted on it so that it is able to the fireplace on enemy remotely whenever required; this isn't always viable until a wireless camera is established. The wireless camera will send actual-time video and audio indicators which can be visible on a far-off reveal and 224 movements can be taken thus. Being in length small of it, will now not be tracked by the enemy on his radar. The robot silently input into the enemy cover or tent and ship us all of the records via its' tiny digicam eyes. It is able additionally to be used for suicide assault if required. Coronary heart of our robotic is microcontroller 8051 own family, we are the use of at89c51 in two microcontrollers in which the first microcontroller which acts as grasp controller, decodes all of the instructions acquired from the transmitter and deliver instructions to slave microcontroller. The slave microcontroller is responsible for executing all of the instructions acquired from the grasp and additionally producing pulse width modulation pulses for the rate manipulate driver circuit which drives 4 nos. of cars. No bumper switch is added BMP 1 and bmp2 so that during the case of twist of fate our battery does now not drains out.

Both the cars will stop immediately and after few 2nd robots will pass on the contrary course take a flip to the left or right path and stops and prevent. Navigation and useless reckoning tilt repayment in inertial sensors, 3-D-gaming. Transmitter gets serial statistics and transmits it wirelessly thru RF via its antenna linked at pin4. The transmission takes place at the rate

of 1kbps10kbps. The transmitted information is received by using an rf receiver working on the identical frequency as that of the transmitted.

Transmission through rf (radio frequency) is higher than IR (infrared) because of many reasons. Firstly, alerts through rf can journey via large distances making it suitable for lengthy variety programs. Also, while it in the main operates in line of sight mode, rf signals can journey even when there's an obstruction among transmitter & receiver. Subsequently, rf transmission is more robust and dependable than or transmission. Rfcommuni   uses a selected frequency does not like or alerts that are affected by different or emitting sources. This rf module contains an rf transmitter and an rf receiver. The transmitter/receiver (tx/Rx) pair operates at a frequency of 433mhz an rf transmitter receives serial statistics and transmits it wirelessly via rf through its antenna linked at pin4. The transmission takes place at the fee of 1kbps-10kbps. The transmitted data is obtained with the aid of an rf receiver running at the same frequency as that of the transmission.

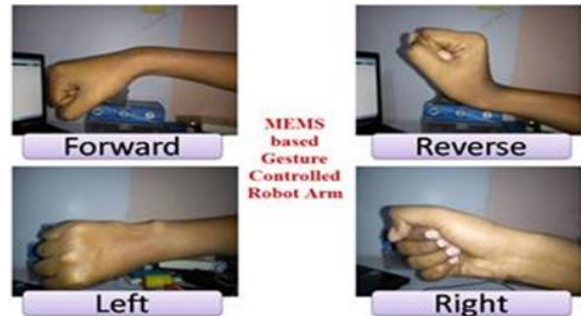


Fig.1.0 Movement Signs

2. SIMULATION WORK

2.1. RF pair

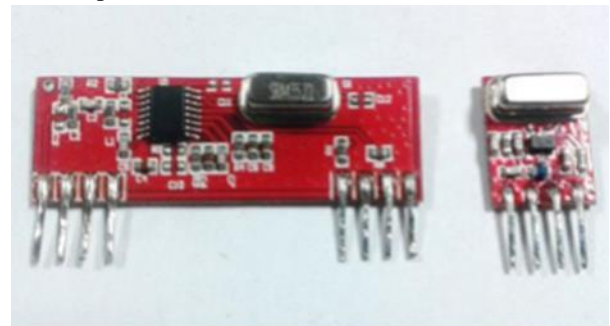


Fig.2.0 Picture of Object

A gesture-managed robot is managed by using the usage of hand in the region of any other method like

buttons or joystick. Here one simplest desire is to transport hand to control the robotic. A transmitting tool is used to your hand which incorporates an rf transmitter and accelerometer. This could transmit a command to the robot so that it can do the required project like shifting forward, opposite, turning left, turning proper, and stop. This kind of responsibility could be executed by way of the usage of hand gestures.

Here the most essential issue is an accelerometer. An accelerometer is a three-axis acceleration dimension device with a $\pm 3g$ range. This tool is made by the usage of polysilicon surface sensor and signal conditioning circuit to degree acceleration. The output of this device is analog in nature and proportional to the acceleration. This tool measures the static acceleration of gravity while we tilt it. And gives a result in the shape of movement or vibration.

In keeping with the datasheet of adxl335 polysilicon floor-micro machined shape placed on top of the silicon wafer. Polysilicon springs droop the shape over the floor of the wafer and provide resistance in opposition to acceleration forces. Deflection of the structure has measured the use of a differential capacitor which comprises unbiased fixed plates and plates connected to the shifting mass. The fixed plates are pushed by using 180° out-of-section square waves. Acceleration deflects the shifting mass and unbalances the differential capacitor resulting in a sensor output whose amplitude is proportional to acceleration. Segment-touchy demodulation strategies are then used to determine the magnitude and route of acceleration.



Fig.3.0 accelerometer

Pin Description of accelerometer

1. GND – Ground.
- 2.X-OUT - This pin gives an analog output in the X-direction.
- 3.Y-OUT - This pin gives an analog output in the Y-direction.
- 4.Z-OUT - This pin gives an analog output in the Z-direction.

5. Vcc - 5 volt supply should be connected at this pin.
6. ST - This pin is employed for the set sensitivity of the sensor.

2.2.Circuit Diagram and Explanation

Gesture Controlled Robot is divided into two parts:

1. Transmitter part
2. Receiver part

In the transmitter part, an accelerometer and arf transmitter unit is used. As we've already discussed that accelerometer offers an analog output so here we want to convert this analog data into digital. For this motive, we've got used 4 channel comparator circuit in place of any ADC. By means of setting reference voltage, we receive a virtual sign after which apply this signal to the ht12e encoder to encode statistics or changing it into serial shape after which ship these statistics through the use of rf transmitter into the surroundings. At the receiver end, we've used the rf receiver to acquire statistics and then applied them to the ht12d decoder. This decoder ic converts acquired serial records to parallel after which examine by means of using Arduino. In keeping with acquired records, we pressure the robot via the usage of the dc motor in ahead, opposite, left, proper, and forestall path.

2.3. Working of Model

Gesture controlled robot movements in keeping with hand movement as we place the transmitter in our hand. When we tilt the hand in the front facet, the robotic begin to shifting ahead and keeps moving forward till the subsequent command is given. When we tilt hand in backward facet, robotic trade its state and begin shifting in backward course till the different command is given. When we tilt it in the left aspect robotic gets flip left till the next command. Whilst we tilt hand in proper aspect robotic turned to proper. And for preventing robots we continue to hand in strong.

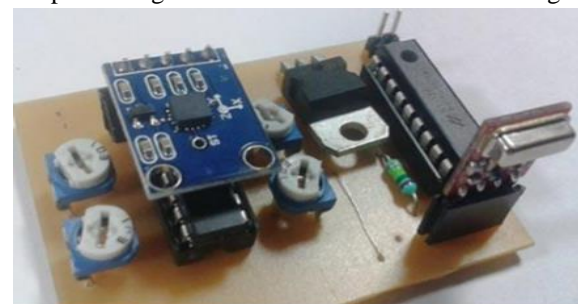


Fig.4.0 Transmitter

2.4. Receiver circuit.

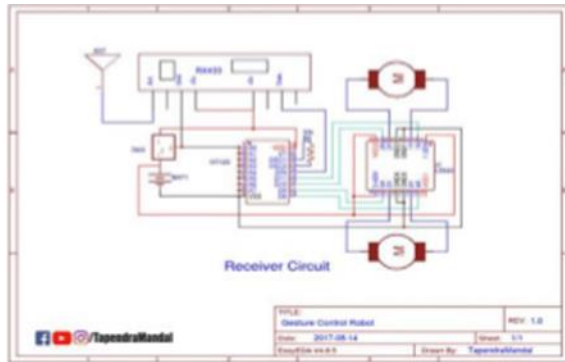


Fig. 5.0 Receiver Circuit

2.5. Transmitter circuit

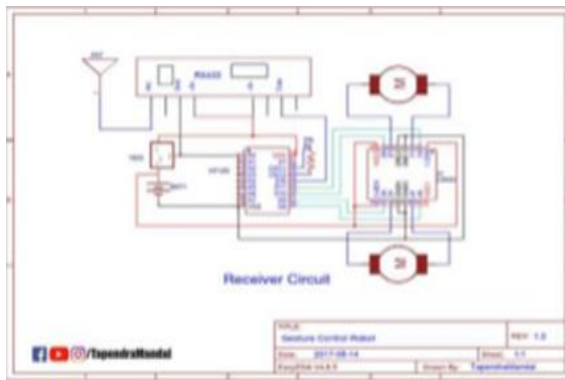


Fig. 6.0 Transmitter circuit

This transmitted sign is received by the rf receiver, demodulated after which surpassed onto the decoder ic. The decoder ic decodes the coded waveform and the unique statistics bits are recovered. The entry is a serial coded modulated waveform while the output is parallel. Pin 17 of the decoder ic is the legitimate transmission (vt) pin. A led may be related to this pin a good way to imply the status of the transmission. Within the case of a successful transmission, the led will blink. Port number 1 is feed with parallel statistics from the encoder of the microcontroller. This statistics is inside the form of bits. The microcontroller reads those bits and takes selections on the premise of these bits. What the microcontroller does is, compares the enter bits with the coded bits that are burnt into this system reminiscence of the microcontroller and outputs on the premise of those bits. Port number 2 is used as the output port for the microcontroller. Output bits from this port are forwarded to the motor driving force ic which drives the automobiles in a special configuration. The gesture-managed robot works on the precept of an accelerometer which facts hand

actions and sends that statistics to the comparator which assigns proper voltage stages to the recorded actions. That statistics is then transferred to an encoder which makes it prepared for rf transmission. At the receiving quit, the records are obtained wirelessly thru rf, decoded, and then exceeded onto the microcontroller which takes diverse choices based totally on the received records. These decisions are handed to the motor motive force ic which triggers the automobiles in unique configurations to make the robot pass in a specific path. The assignment becomes divided into two parts to make the task smooth and easy and to keep away from complexity and make errors unfastened. The first is the transmitting segment which incorporates the subsequent components:

Accelerometer, encoder ic, rf transmitter module. The second one is the receiving end which comprises of following major components: rf receiver module, decoder ic, microcontroller, motor driving force ic, dc vehicles. The accelerometer facts the hand actions inside the x and y directions only and outputs steady analog voltage levels. Those voltages are fed to the microcontroller which techniques the input and encodes the information into digital form which is suitable to be transmitted through the XBee serial transmitter. The circuit for this hand gesture-managed robot is quite simple. Rf pair connected in Arduino is shown in the schematic diagram and it is used for communication. The motor driving force is connected to Arduino to run the robotic. Motor driving forces enter pin 2, 7, 10, and 15 are hooked up to Arduino digital pin variety 6, 5, 4, and three respectively. Right here we have used dc automobiles to pressure robots in which one motor is connected at the output pin of motor driving forces three and six and another motor is attached at 11 and 14. A 9-volt battery is also used to power the motor driver for driving vehicles.

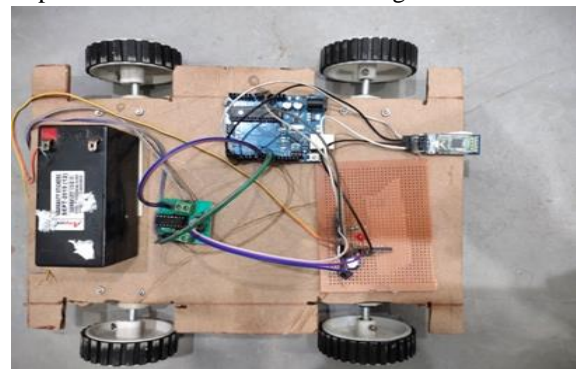


Fig. 7.0 Ready Model

3. CONCLUSION

The cause of the assignment is to control a toy vehicle by the usage of accelerometer sensors connected to a hand glove. The sensors are intended to replace the far-off management that is usually used to run the automobile. It'll allow us to govern the forward and backward, and left and right actions, while the use of the equal accelerometer sensor to govern the throttle of the car. Primarily based on the hand actions. By the usage of the above referred to additives, the hardware turned into setup, thus resulting in the formation of a robotic. That allows you to implement the experiment a dell pc became used, whose net camera acted as the input device for taking pictures of the video. The software program element turned into advanced in java for photograph processing in which the hand gestures were analyzed to extract the real path. Eclipse ide has become used for growing the java code. The path therefore identified was send as characters to the robot with the help of ZigBee. Xbee s2 model of ZigBee become used for allowing the communicate. The final motion of the robotic may be concluded as follows: at the beginning, the robotic was in a forestall mode. As the hand moved from bottom to top, the robotic moved in the ahead direction. Because the hand moved from pinnacle to backside, the robot moved in the backward path.

Because the hand becomes proven as an acute perspective closer to the left, the robot moved towards the left course. Because the hand changed into shown as an acute attitude towards the right, the robot moved closer to the proper direction. As the hand is saved desk-bound with appreciation to the environment, the robotic became within the forestall mode. From the test, about eighty% of the implementation worked according; the remaining became much less because of heritage interference that's a bad marking to the implementation. Hand gesture-controlled robotic gadget gives a more natural manner of controlling gadgets. The command for the robotic to navigate in the specific path in the surroundings is based on the technique of hand gestures furnished with the aid of the user. Without using any outside hardware guide for gesture input, not like a particular current machine, the consumer can manipulate a robotic from his software station.

4. FUTURE SCOPE

The onboard batteries occupy a whole lot of area and are also quite heavy. We will either use a few exchange power sources for the batteries or replace the present-day dc motors with ones that require much less electricity.

The proposed gadget is applicable in unsafe surroundings in which a digicam can be attached to the robotic and can be considered by using the person who's in his station. This device can also be employed in a clinical subject where miniature robotic are created which can assist medical doctors for green surgical procedure operations for greater efficient response, threshold values can be used to hit upon gesture and advanced functions consisting of finger counts that offer different functional commands can be used.

Entertainment applications - Most videogames nowadays are played either on recreation consoles, arcade devices, or pcs, and all require a mixture of entering gadgets. Gesture reputation may be used to absolutely immerse players in the game international like by no means before.

Automation systems - In houses, offices, transport cars, and more, gesture popularity can be integrated to significantly grow usability and decrease the resources essential to create primary or secondary input systems like faraway controls, vehicle leisure systems with buttons, or comparable.

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