Vehicle Controlled by Hand Gesture Using Raspberry pi

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Abstract- *The disabled person gets the most from hand-operated vehicles since they can move in the direction, they wish to go without having to punch any buttons. This system includes a glove with a receiver circuit mounted on top and an Atmega microcontroller connected to an accelerometer that the user is expected to wear while operating the device. RF receiver, Arduino micro, Raspberry pi Pico, and Driver IC are all components of the vehicle's circuit. The Arduino mini transmits the orders that are received by the IC on the circuit to the RF receiver, which then sends the signal to the motor driver, driving the motors in turn.*

Keywords- raspberry pi Pico, RF receiver, automatic vehicle atmega 328, RF transmitter, DC motor

1. INTRODUCTION

Everything in today's world is automated, and artificial intelligence has taken over the market. One of the key components of innovation is robotics. Artificial intelligence and robotics are unrelated but distinct fields. Robotics is the process of building machines that can carry out activities without human assistance, whereas AI is the process through which machines mimic human decision-making and learning. Although robotics can have an AI component (and vice versa), both can exist independently of one another and typically do. Most simple, repetitive task-performing robots don't require sophisticated AI because their jobs are straightforward, predictable, and pre-programmed.

However, many of these AI-free robotics systems were developed keeping in mind the past limitations of AI, and as the technology continues to advance at a breakneck pace every year, robotics manufacturers may feel more confident in pushing the boundaries of what is possible when combining the two disciplines.

A robot is a machine that can automatically complete a complex series of tasks, especially one that can be programmed by a computer. A robot can be directed by an internal control system or an external control device. Although some robots are built to resemble humans, most robots are task-performing machines that place a greater focus on bare utility than on expressive aesthetics.

A robot that can be controlled by gestures rather than conventional buttons is known as a gesture-controlled robot. You merely need to carry a little transmitting device with an acceleration metre in your hand. This will send the robot the appropriate instruction so that it can perform whatever task we ask of it.

Robot controlled by gestures moves as our hands develop as we hold the transmitter in our hands. Robot starts moving forward when we turn toward the front and continues moving forward until the next command is delivered. Robot changes state and starts moving in reverse direction when hand is tilted to the opposite side until another command is provided. When we turn it to the left Robot moves left and in the following direction. Robot rotated to the right when we inserted our hands. Additionally, in order to halt the robot, we maintain stable hand.

The main goal of this project is to use an accelerometer and a Raspberry Pi Pico to control the evolution of the robot with hand gestures. Typically, a robot is a machine that operates autonomously through hand motions.

2. LITERATURE SURVEY

Since a long time ago, robotic vehicles have been operated by hand gestures in both the transform and spatial domains. In this section, a few techniques have been examined.

Nitin Garg and Chirag Gupta have proposed a method. A gesture-controlled robot, or "gesture-controlled car," is one that may be operated with hand gestures rather than the more traditional way of pressing buttons. Simply put, the user must wear a tiny transmitting gadget with an accelerometer-type sensor on his hand. An extremely precise hand movement can send an instruction to the robot, which can then move in that exact same direction. The transmitting device has an encoder IC for encoding the four-bit data so that it can be communicated by an RF transmitter, as well as a comparator IC for allocating the proper levels to the input voltages from the accelerometer.

It is feasible to move a robot in accordance with gesture detection, according to a technology developed by Archika et al.1 that uses an accelerometer sensor. The

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

primary technologies for interacting between humans and machines, accelerometers provide extremely decent motion sensitivity in a variety of applications. Motion technology makes it easier for people to interact organically with machines without the need for modifications brought on by mechanical equipment' shortcomings. Its low-moderate cost and the relatively modest size of the accelerometers are the characteristics that make it an excellent tool to detect and understand human gestures.

The Hand Gesture Controlled Robot Using Arduino was presented by Ms. Asmita Jadhav. This paper introduces an Arduino-based Hand Gesture Controlled Robot that can be operated with a single hand gesture. The accelerometer starts moving in response to a person's hand movement. Based on three accelerometer axis, the robot can move in four directions: left, right, forward, and backward. We employ an infrared sensor with a 790nm wavelength range to detect human movements. This kind of robot is frequently employed in industrial robotics, the construction industry, and military applications. In such a field, it is extremely dangerous and challenging to operate the machines using switches or remotes, and occasionally an operator may become confused as a result. This novel concept brings machine control through hand motion.

Human-computer interaction (HCI) is becoming the most important topic for researchers and scientists, according to Soubagya Nayak, as a result of the relentless juggernaut of computing advancements and artificial intelligence creeping into our lives. However, the traditional HCI approach of using a mouse and keyboard makes life boring and stifling. In order to improve the quality of life for the elderly and physically disabled, it is imperative that gesture control technology be improved. Our research moves forward with the lofty goal of creating a modernized environment for HCI by eliminating all the undesirable, antiquated, traditional communicating peripherals like the keyboard and mouse. It illustrates the use of a 3-axis accelerometer sensor and hand gesture control to operate a robot.

3.COMPONENTS

The list of components used: -

3.1 Battery: - An electrical battery is made up of one or more electrochemical cells that work together to transform chemical energy that has been stored away into electrical energy. For many domestic and commercial uses, batteries are now a standard power source.

3.2 Voltage Regulator: - The three-terminal positive regulators of the LM78XX/LM78XXA series come in the 10-220/D-PAK package and include a number of set output voltages, making them useful in a variety of applications. Internal current limiting, thermal shutdown, and safe operating area protection are all used by each kind, making them virtually indestructible. They can deliver more than 1A of output current if sufficient heat sinking is offered.

3.3 Raspberry pi: - The system on chip (SOC) board for the Raspberry Pi is manufactured by Broadcom (BCM2835). It has an ARM1176JZF-S core CPU, 256 MB of SDRAM, and a clock speed of 700 MHz The Raspberry

Fig-1: Raspberry pi

Pi USB 2.0 ports only support external data communication. The micro-USB adaptor, with a minimum range of 2. Watts, provides power for the board (500 MA). The purpose of the graphics-specific chip is to accelerate the processing of picture calculations. This has a Broadcom video core IV wire built into it.

3.4 Push buttons: - Push buttons can be mechanically linked together in industrial and commercial applications so that pressing one button releases the other, allowing a stop button to "compel" a start button to release. When a machine or process does not include electrical control circuitry, this form of linking is employed for straightforward manual actions. In order to prevent operators from pressing the incorrect button, pushbuttons are frequently color-coded to correspond with their functions.

3.5 Motor Driver: - Two integrated H-bridge driver circuits are present in L293D. Two DC motors can be run concurrently in both forward and reverse directions in its usual mode of operation. The input logic at pins 2 & 7 and 10 & 15 can control the motor operations of two motors. The matching motor will stop if input logic is 00 or 11. It will rotate counterclockwise for logic 01 and clockwise for logic 10, accordingly. The two motors' respective enable pins I and 9 must be high for the motors to begin running. The linked driver is enabled when an enable input is set to high. The outputs thus become active and operate in synchrony with their inputs. Similarly, that driver is disabled and their outputs are not active when the enable input is low.

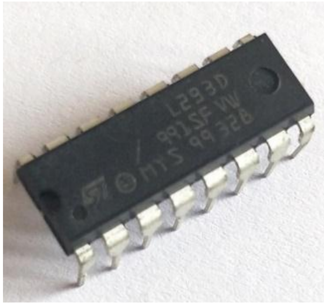

Fig-2: Motor

3.6 DC motor: - Axle, rotor (also known as armature), stator, commutator, field magnets, and brushes are the six fundamental components of a DC motor. High-strength permanent magnets are used to provide the external magnetic field in the majority of typical DC motors. The motor's stationary component, known as the stator, consists of the motor casing and one or more permanent magnet pole pieces. In relation to the stator, the rotor revolves. The commutator is electrically coupled to the windings that make up the rotor, which are typically on a core. When power is provided, the activated winding and the stator magnet(s) are mismatched due to the geometry of the brushes, commutator contacts, and rotor windings. As a result, the rotor rotates until it is almost aligned with the stator's field magnets. The brushes advance to the following commutator contacts as the rotor aligns and energize the following winding. With regard to our two-pole example motor, spinning causes the current flowing through the rotor winding to reverse direction, causing the magnetic field of the rotor to "dip," which causes the rotor to continue rotating.

3.7 RF Transmitter: - The best option for wireless control applications needing short range and good quality is this PLL-based ASK Hybrid 434 MHz RF transmitter module. A SAW-stabilized oscillator is used in the transmitter module to ensure precise frequency control for optimal performance over the broadest feasible range. The transmitter's 3-to-12-volt power source range makes it ideal for battery-powered applications.

Fig-3: RF Transmitter

3.8 RF Receiver: - The modulated RF signal is fed into an RF receiver module, which demodulates it. Super-regenerative receivers and super-heterodyne receivers are the two different types of RF receiver modules. Super-regenerative modules often employ a series of amplifiers to separate modulated data from a carrier wave in low power, low-cost designs.

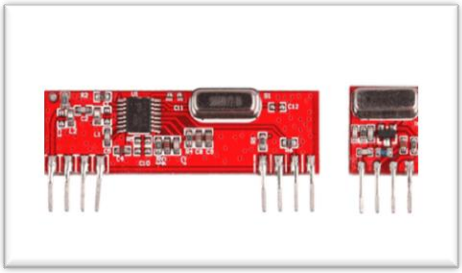

Fig-4: RF Receiver

3.8 Diodes: - The highest reverse bias voltage capacity of diodes with the numbers IN4001, IN4002, IN4003, IN4004, IN4005, IN4006, and IN4007 is 50V, while the maximum forward current capacity is 1 Amp. Similar-capacity diodes can be substituted for one another. In addition, a diode with a higher capacity can be used in place of a diode with a lower capacity, but the reverse is not true.

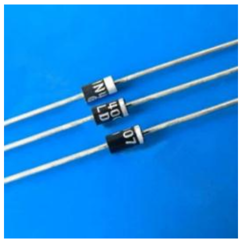

Fig-5: Diodes

3.9 **Accelerometer: -** The user can better grasp an object's surrounds thanks to accelerometers. This little device lets you tell whether anything is flying horizontally or angling downward, whether it would topple over if it tilts any farther, and whether it is travelling uphill. The most popular type of accelerometer uses the piezoelectric effect, which relies on small crystal formations that are strained by acceleration forces. The tension on these crystals generates a signal, which the accelerometer interprets to calculate velocity. and direction. The capacitance accelerometer detects changes in capacitance between nearby microstructures. When one of these structures is moved by an accelerative force, the capacitance will vary, and the accelerometer will convert this change to voltage for interpretation.

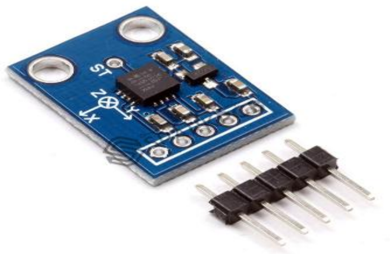

Fig-6: Accelerometer

4.WORKFLOW

4.1 Transmitter Section

The transmitter part of this project contains a Raspberry pi pico and adxl335 accelerometer and RF receiver module.

The adxl335 accelerometer provides output in the form of coordinates and we can read the output sent by the accelerometer. ADXL335 has the ability to provide the co-ordinated in x, y, and z-direction. But since we don't need the z-axis values we don't connect it to the Arduino.

The purpose of the transmitter is to calculate the direction the hand has been tilted and send a message to the receiver corresponding to it. The x and y-axis values can be interpreted to provide the tilt direction to control the motor spin.

The x and y-axis pin of the adxl335 provides an analog output because of which they are connected to the analog pins of the Pi.

Inside the while loop, we set the x-value and y-value as integers and store the x-axis value and y-axis value received from the adxl335 accelerometer in it.

The stored value in the integer is then displayed on the serial monitor and after a 2-second delay, it displays the new x-axis value and new y-axis value.

We note down the range for the forward tilt we take a reading when the hand is slightly tilted and do another reading when the hand is tilted to the maximum angle. With these values of x and y, we get a range for x and a range for y.

Similarly, we take the reading for the backward tilt of the hand, right, left, and stationary tilt of the hand.

After noting down the range of x and y in forwarding, backward, left, right, and stationary positions of hand we move to coding the final code using micro python in thonny ide. We start by including the virtual wire library which is necessary for transmitting and receiving any message through the rf transmitter and receiver module. 3 integers are defined here two for x and y values which are analog values and one integer as led13 which is the inbuilt led. We set pin13 as output. In the void loop, we start by assigning the x-value and y-value sent by the adxl335 accelerometer to the x-value and y-value.

Next by using if-else statements we write that if the x-value and y-value fall under the range (xval>395 && xval<416) && (yval>360 && yval<380) then the hand is tilted forward and the transmitter module sends a letter “f” to the receiver, similarly for backward right-left stationary letters “a” “r” “l” ”s” are sent respectively, and every time a signal is sent for forward-backward left-right the inbuilt led at pin13 is turned on.

4.2 Receiver section

The transmitter section sends the corresponding letter to the receiver after determining whether the hand is tilted backward, left-right, or stationary. Before the receiver can use this code and decode it, we need to get a few more readings.

The receiver section of this project consists of an l293d motor driver 2 motors an rf receiver module and a switch.

L293D is a motor driver IC which is useful when we wish to control the direction of the motor spin without disconnecting the motor and switching the polarities. The IC pin out has been attached whit this paper. We can see that the IC has 2 enable pins. Whenever these pins are made high only then do they allow for that side of the IC to be enabled. The IC has 4 input pins and 4 output pins. Output one and output two are connected to the two terminals of the battery and outputs 3 and 4 are connected to the two terminals of another motor. The input 1,2,3, and 4 are connected to Arduino and the Arduino gives the signal for the direction of motor spin via these pins. we detect how the input values need to be changed for the motor to spin in the desired direction by writing a simple code on thonny ide.

In this code, we start by naming the pins connecting the pico with the IC.

Then by digitally writing the values of input 1 2 3 and 4, we note down the combination for which both motors spin forward, both the motors spin backward, one spins forward while the other doesn't move, and vice-versa. By this, if we want the motor to take a right turn we know which input to set as high and which input to set as low to achieve this condition.

After this, we move on to writing the final code.

Here we receive the letter sent by the transmitter signal. If the signal received is f then we turn the input pins of the IC as high and low for the vehicle to move forward. Similarly, it is done backward, left, and right.

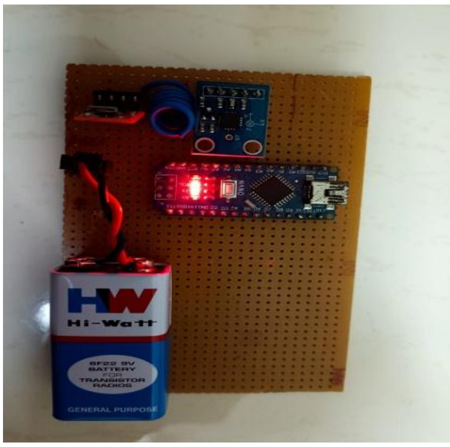

Fig-7: Image of Receiver

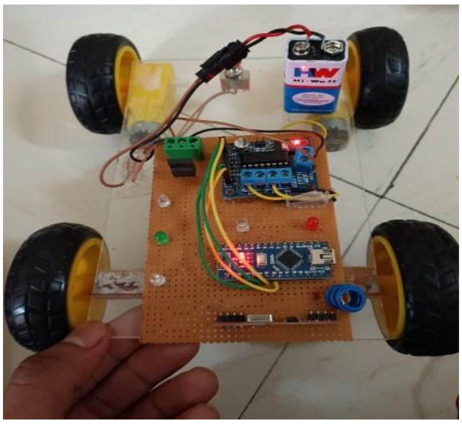

Fig-8: Image of Transmitter

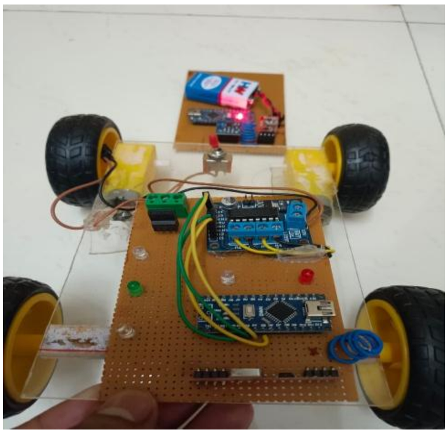

Fig-9: Assembled image of robotic vehicle

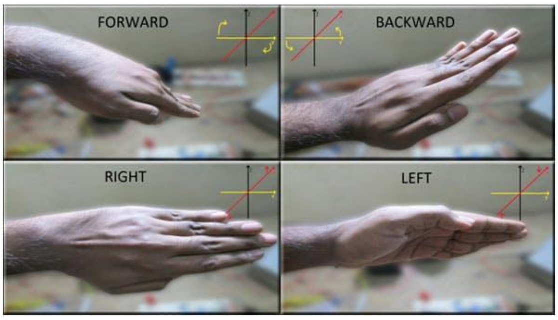

Fig-10: Hand gesture for moving the vehicle in forward, backward, right and left direction

5. CONCLUSION

The system's objective is to use a Raspberry Pi Pico to construct an accelerometer-based hand gesture-controlled car. Simple movements can be used to move it in any direction, and we can successfully balance the system's responsiveness to motions to suit our preferences.

After carefully studying this system, we have come to the conclusion that when a person moves their hand in any of the four directions—Left, Right, Down, or Up—the accelerometer will identify changes and send a certain signal to the next order. accelerometer → raspberry pi Pico → encoder → transmitter → decoder → motor driver → motor. The suggested method can be used in hazardous environments when a vehicle-mounted camera can be observed by the user. This technique can also be used in the medical industry, where small robots have been developed to aid surgeons in performing effective surgeries.

The system's real-time palm gesture detection feature, which enables intuitive and efficient vehicle operation, is one of its key advantages. By properly installing the sensor, the vehicle can be improved to detect people buried under earthquake and landslide debris. The vehicle can be equipped with a GPS device to track its location. The tool may also be utilized by the military to keep an eye on battlefield locations devoid of human activity.

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