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Gesture Controlled ATV

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Abstract: All terrain vehicles (ATV) are used in difficult and harsh terrain for mobility and logistic support. An electrically powered ATV is silent, agile and robust. This vehicle can be used to carry the heavy and bulky items of user while they navigate through offroad terrains. In the proposed system, we implemented control of all terrain vehicle using gesture based control logic on Arduino Microcontroller. We will read the data from different sensors and communicate with ATVs ECU(Electronic control unit) to move the vehicle in desired direction in controlled manner.

Keywords: Hand Gesture, Gyroscope, ARDUINO, ATV, MPU6050

I. INTRODUCTION

As the use of robots in several fields has been increasing day by day in doing different types of works. To make some complicated works easy in industrial areas, military purposes and in any places where humans can't go, gesture-controlled robot are used where the motion of robot depends upon human hand. Here the most important device the MPU6050 sensor which has 6-axis of motion tracking device in which accelerometer has 3-axis, and other 3 axis for gyroscope and addition to that it also has feature like temperature sensor. Inertial measurement unit has acceleration as well as gyroscope values. Accelerometer meter is a device used to detect acceleration of different possible. The accelerometer is the 3 axis estimation gadget. Results and Readings of MPU6050 are digital in nature corresponding to the acceleration. When we tilt MPU6050, it measures static acceleration of gravity and gives an outcome in type of movement or vibration. It detects the hand position and generates coordinates. So that it can perform the movement task.

II. GESTURE CONTROL MODE

Gesture control is technology that uses hand gestures to sense and to read and interpret hand movements as commands. By using this, computers are able to understand language of human body. It builds a richer bridge between computers and humans. To interact with computer system, hand gestures are used to interpret human body language. In the automotive industry, this capability allows drivers and passengers to communicate with the vehicle, usually to control the infotainment system without touching any button and screen.

III. BLOCK DIAGRAM

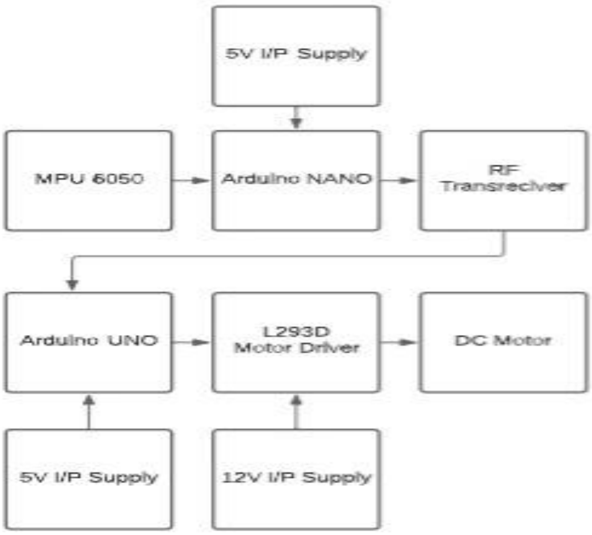

Fig. 1 Block diagram of proposed system

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III. BLOCK DESCRIPTION

Block diagram of Gesture control ATV is shown in the figure with explanation

- Base station: Computer system remotely placed from ATV which can be controlled by using keyboard, mouse or hand gesture.
- Mouse and Keyboard: Used to control the motion of the ATV.
- On-board system: A computer system placed on the ATV itself which receives the commands and delivers it to the Control Unit.
- Control Unit: It's the Arduino microcontroller which receives signals from the user and other sensors and performs tasks ATV movement.
- DC motor: These are used mainly for the ATV movement.
- 12V Battery and voltage regulator: the power source supplying the entire ATV with voltage regulation to provide opt MPU6050m power ratings.
- MPU6050: An inertial measurement unit that tracks the orientation of the hand used for hand Gesture control (ArmCon mode).
- 5V Battery: Used for powering up the Control Unit, NRF24L01 and the MPU6050.

The hardware components used in the Unmanned ground vehicle are:

- ARDUINO MICROCONTROLLER
- DC MOTOR
- MPU6050
- NRF24L01 TRANSMITTER
- NRF24L01 RECEIVER
- L293D MOTOR DRIVERS
- 5V BATTERY
- 12V BATTERY

V. SOFTWARE AND CODING

Mainly two softwares are used to complete the entire project work.

3.1 Arduino

It is an open source platform based on an easy-to-use hardware and software. It has circuit board, which can be programed and a ready-made software called Arduino Integrated Development Environment, which is used to write and upload the computer code to the physical board.To give more accessibility, arduino has standard form factor which breaks functions into more packages. The Arduino platform has become very popular with people new to electronics, and for good reason. Arduino uses C++ as coding language which is easy to learn.

3.2 Circuito.iO:

Circuito.io is an online tool which is used to design complete electronic circuits.It builds accurate circuits instantly. It also has a feature that allows us to drag and drop several parts together. It also has three different sections that one needs to work on before testing, and the first is the Bill of Materials (BoM) called Design.

VI. POSITION ESTIMATION ALGORITHM

To calculate the movement of the MPU6050, change in position of ATV must be known. The acceleration of the MPU6050 must be converted into actual displacement in meters. For any moving body, with an acceleration „a", its velocity "v" can be obtained by integrating acceleration with time,"t".

$v = \int a.\, dt$ (1)

Displacement "x" can be calculated by integrating velocity with time.

$x = \int v.\, dt = \int (\int a.\, dt)dt$ (2)

The formula defines the integral as the area under the curve, where the sum of integration is infinitely small areas with width nearly equals to zero. As, we require real time displacement updates from discrete input values. Thus, trapezoidal integration is used here. This integration is a method that uses the current and previous measurement to determine the integrand. Suppose there is n such samples of signal, then we can obtain first order approximation of signal as follows. To avoid confusion, sampling time S is taken as unity.

$$Area_n = Sample_n + \left(\frac{Sample n - Sample\ n-1}{2}\right) * T \quad (3)$$

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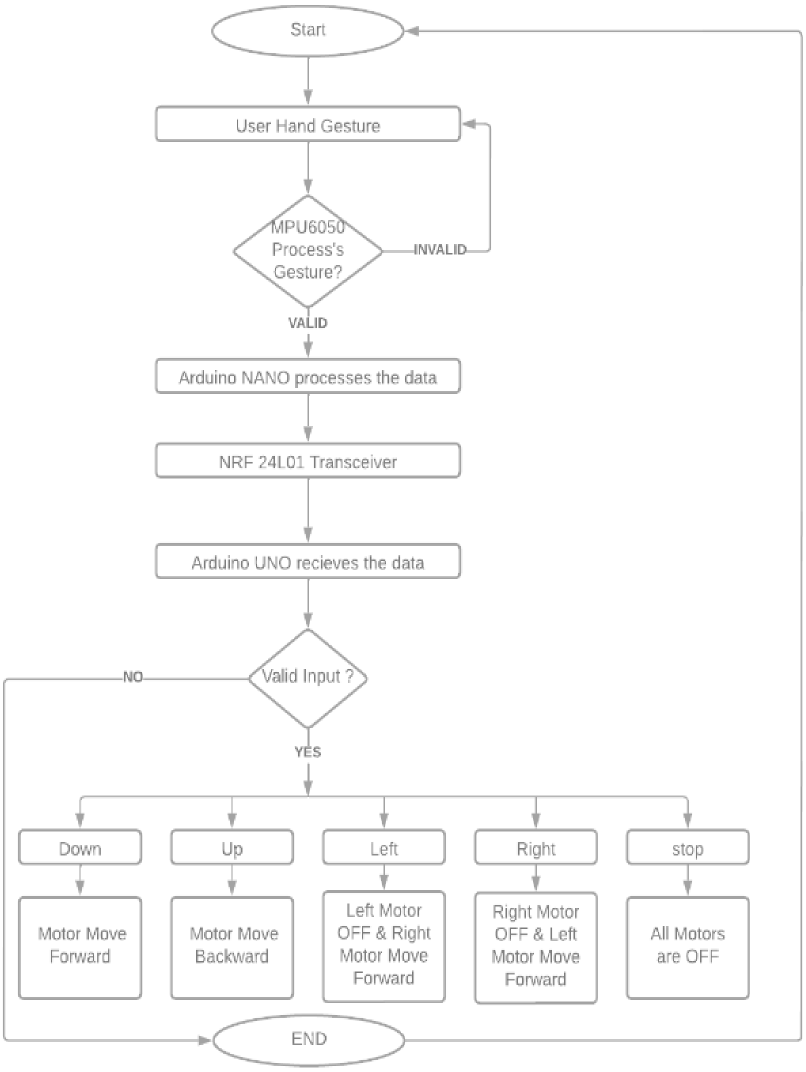

Fig. 2. Algorithm

With this algorithm, we will obtain displacement values from each axes from acceleration. At first, we have to configure power register and other configuration register to initialise the MPU6050. For real world interpretation of data calibration should be done before taking the samples. Calibration is performed on the accelerometer by reading the data registers when there is a no movement condition. To obtain the actual acceleration, the zero point reference is subtracted from the measured sample value. Accelerometer outputs the linear acceleration on each axis are in G‟s, where 1G = 9.8 m/s2. So, we will convert the acceleration values in m/s2. Then integrating the acceleration will give velocity(m/s), and a position(m). First order integration is done by using equation (3).
As per the Newton's first equation of motion (v = u+at),
Current velocity = Previous velocity + (Current acceleration * Sampling time). (4)
Similarly, integration of velocity values will give the displacement.
Current displacement = Previous displacement + (Current velocity * Sampling time). (5)
The obtained change in position values in X and Y directions are stored and repeat above steps.

VII. EXPERIMENTS READING

This project is aimed to estimate the displacement of a ATV by using MPU 6050 sensor. So, the initial stage was to design and setup the chassis of the robot. We have used acrylic material of thickness 6mm to build the entire body of robot. Fig.3 shows the structure of the robotic vehicle used for this study. DC motors are controlled by PWM signals. NRF24L01 is interfaced with I2C in ARDUINO board. MPU 6050 sensor interfacing uses I2C0. Connect Ultrasonic sensor with GPIO pins of ARM board. For the objective of this study, the position of the mobile robot is estimated by using MPU6050.

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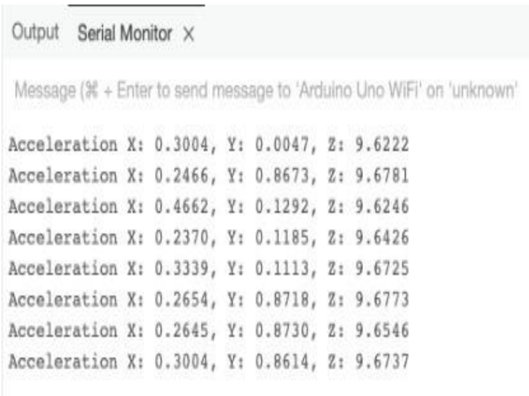

Fig. 3 Displacement in x axis vs Time

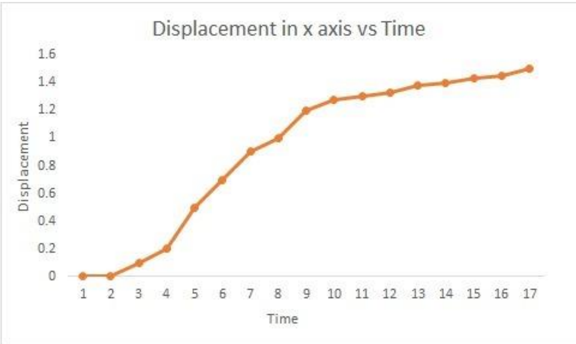

Fig. 4 Displacement in x axis vs Time

Fig. 5 Displacement in x axis vs Time

MPU 6050 Data Reading

I2C communication is used to interface MPU6050 with ARDUINO. Raw values are read from the accelerometer and gyroscope data registers directly 16-bit bit values are obtained by combining the lower 8bit and higher 8bit data register values. After the integration of accelerometric data, velocity values are obtained. To get displacement in X and Y axes, we have integrated velocity values. These values are sent to the central PC through the wireless module NRF24L01. Fig.4 shows the MPU 6050 data plotting of displacement of the vehicle. We can see that within 15secs, the vehicle displacement in X- the direction is 1.5 meters and in Y-direction is about 1.3 meters from the starting point.

VIII. RESULTS

In our project, a comparative study of displacement estimation of autonomous mobile robot with the help of inertial sensors are presented. We successfully built a mockup of ATV capable of being controlled using hand gestures. Likewise, in command-controlled mode and self-controlled mode, we used another specific mode called, gesture control mode (ARMCON mode). In this mode, in this mode, ATV is maneuvered using commands sent based on hand gestures movement by the MPU 6050 unit. The complete setup and working of the gesture control mode ATV are described in the paper. Similar to command controlled and self-controlled ATV, This gesture-controlled ATV can also undertake missions like border patrol. In the future, the errors in MPU 6050 measurements can be reduced by the implementation of an extended Kalman filter-based algorithm.

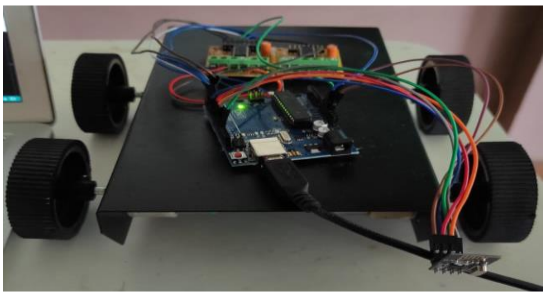

Fig 6 Hardware Model

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