3 Axis Gimbal Affixed Rover

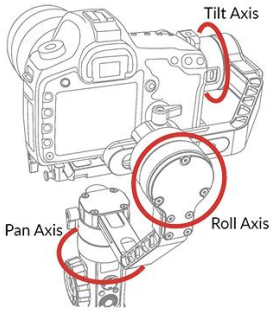
V.Ashwin Kumar[1], A.Deepak Kumar[2], Harish Nagarajan[3], K.Mahesh Ram[4], Keerthana[5]
[1, 2, 3, 4] Dept of MCT
[5]Assistant Professor, Dept of MCT
[1, 2, 3, 4, 5] Rajalakshmi Engineering College, Chennai, India

Abstract- *The Proposed system "3 Axis Gimbal Affixed Rover" is designed to operate on rough and harsh environments with image stabilization. In uneven or rugged terrain, the image capturing becomes jittery and blurry hence the control of rover becomes difficult so the focus of our research is to overcome restrictions by providing 3-axis image stabilization for smooth image capturing and processing for better control of the rover. The rover has been designed based on rocker bogie mechanism and has 6-wheel drive. It is made from aluminum to increase its strength to withstand shocks, vibrations and mechanical caused by the environment. The 3-axis gimbal is equipped with brushless dc out runner motor for smooth and quicker image stabilization. It is controlled using a storm 32 controller board. The image processing and controlled using raspberry pi 4. The rover has been designed using solid works. The system is used to overcome unstable image recording due to the motion caused by the mobility of the rover by using Gimbal which is placed on the frame. Stable image capturing can be achieved by this system on various terrain.*

Keywords- Rocker-Bogie, Gimbal and Stable image.

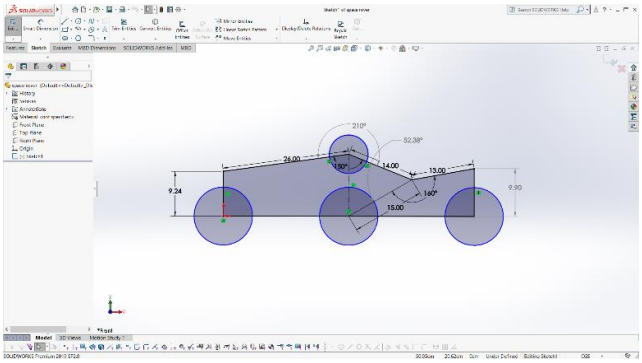
I. INTRODUCTION

With the advances in technology and the improvement like automated aiming of the camera at a Region of Interest (ROI). However, The word GIMBAL is defined as a support which is pivoted and allows the rotation of any object in a single axis. Three axis gimbal does this work in all the known axis for the object mounted on it. It dictates the movement of the object not with respective to the one carrying it. The 3-axis of movement are specified into certain naming axis, The Tilt, Pan & Roll. The Tilting is moving up and down. Panning is moving from left to right and vice versa. The roll is moving back and forth.



The Rocker Bogie designed rover is made in order to ensure, optimize the suspension system of all-terrain mobile robots to improve its mobile performance rocker-bogie suspension system is successfully used in the Sojourner Mars Rover. The rocker-bogie suspension system is a passive springless and symmetric mechanism. The rocker is connected to the rear wheel, and the middle wheel and the front wheel are connected by the bogie.

The design consists of a spring free suspension based differential drive system that allows the bogie to move over rocks, pebbles with ease. The rocker bogie mechanism was designed keeping this in mind by providing maximum stability in all terrains.



II. IDENTIFY, RESEARCH ANDCOLLECT IDEA

We proposed about the research, observation and finding that have been made regarding this project field. The discussion starts from acquiring a stable video footage from any type of a camera and that should be set in a motion, The whole system should be Mobile. All the related research

papers and journals that provide thought and concept concerning this project ground also is explained into a simple means.

2.1."Optimization of stabilizing the video footage in mobile conditions."

Author: Gimbal Guru

The Guru 360° Rover for camera systems up to 20lbs or 9kg. The Guru 360° Rover moonwalks through the scenery. The rover's visible profile is unnoticeable to single lens camera and almost invisible to 360 cameras. Think of the Guru 360° Rover as a robotic camera assistant that is always happy to hold the same position, and ready at a moment's notice to move when commanded.

2.2 "Smart technology used take precautions from hazards"

Author: Mike Wehner, NASA/JPL-Caltech

The "Mastcams" are affixed to the rover's robotic arm, giving them great flexibility, while the hazard cameras, or "Hazcams" examine the ground immediately surrounding the rover.

2.3 "Theoretical Three and Four-Axis Gimbal Robot Wrists"

Author: L. Keith Barker and Jacob A. Houck

This paper examines the kinematic rotation of the robot hand by its wrist in response to rotational velocity commands from an operator or a computer program. Two robot-wrist configurations are assumed, namely, (1) a true three-axis gimbal robot wrist and a four-axis gimbal robot wrist. The objective is to rotate the robot hand with a three-gimbal robot wrist and with a four-gimbal robot wrist in an attempt to move the tip of the probe in the robot hand in this prescribed ideal manner.

3. EXISTING SYSTEM

In the existing system, A standard RC car with four wheels that can rotate 360 degrees, for tighter maneuvering and better control. It looks to be using a battery similar to DJI Matric drones. The wheels are separated from the camera section with arms that can move up and down, reducing movement in the camera. The camera is then placed on top of a platform with dampers on the bottom and shocks attached with arms to further remove vibrations. The attached camera looks to be from the Zenmuse family and is likely interchangeable with the Inspire drones. The height of the camera car can also be adjusted to better suit the different speeds the car is capable of.

This system has a disadvantage because during off-road condition the shake might occur and lot of which cannot compensated by the gimbal mechanism

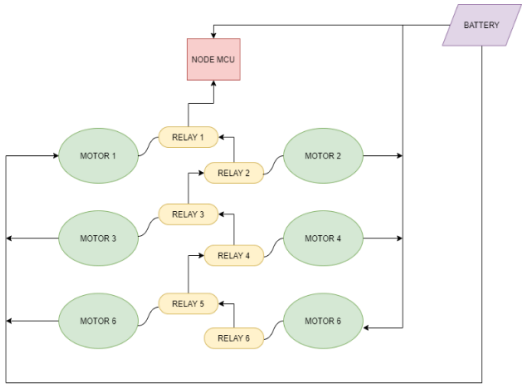
IV. PROPOSED SYSTEM

In our project we have proposed an idea that would combine both Gimbal and Rover to obtain a stable system which can record a video footage on Motion. Also the capability of recording in various terrain and extra damping feature is added. The scope of this project is mainly used in Cinema industries and During emergency situation like Man-made disaster [eg- Collapsing of buildings]. Thus, human intervention in dangerous areas can be avoided. Gimbal is affixed to provide more clarity in image.

4.1 BLOCK DIAGRAM WITH EXPLANATION

This is the basics flow diagram which states the flow of control. As the PI camera captures the image which is mounted on the 3-Axis gimbal. Strom 32 is the controller which is used to process the numerical and counter act the motion. The image captured is sent to raspberry pi 4 where the OpenCV is installed for image recognition and obstacle detection. All these components or mounted on the rover.

4.1.1 FLOW DIAGRAM FOR ROVER

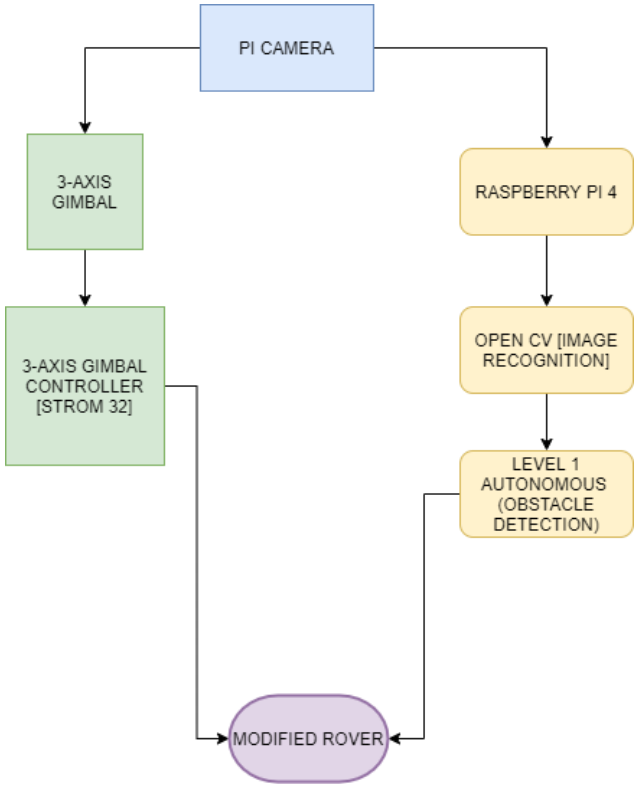


ROVER FLOW CHART

In this flow nodeMcu is the controller which controls the motor by energizes the relays. The whole set up acts as a master-slave with raspberry pi4. The master is the raspberry pi and the slave is the nodeMcu. The Battery unit is common for both gimbal and rover.

4.2 Hardware and Controlling.

The Hardware platform will be the Raspberry pi.



4.3 Raspberry pi 4

Raspberry Pi is a series of small single board computer. It has BCM2837B0 System on chip. It has 4 GB RAM at 900Mhz.It has Broadcom VideoCore Graphics. It has quad core ARM cortex-A53 processor.

4.4 iPower Motor GBM2804H-100T GBM2804 2804 Brushless Gimbal Motor

The GBM2804H-100T motor by iPower Motors are the ultimate brushless gimbal motor for GoPro Cameras. This motor is designed for small multi-rotor platforms looking to lift GoPro sized gear – 0.5-1KG/cm Torque. The principle of the camera stabilization using brushless direct drive motors In fact, gimbal based on BLDC motors is very similar to regular gimbal based on hobby servo.

Specifications:

- Model No.: GBM2804H-100T
- Weight:41.5g
- Motor Diamension:34mm*hgt15mm
- Stator Diameter: Día 28mm*hgt 4mm
- Copper Wire (OD):0.19mm
- Configuration:12N14P
- Resistance:11.2ohms
- Base center pitch:16mm 19mm
- Pre-wound: with 100 turns hollow shaft
- Camera range (Torque):200g-400g
- Test Voltage:11.1V
- Max Voltage:14.8v
- Test Current:0.0099A
- Max Current:5A
- Test Rotational Speed:1637 rpm
- Max Rotational Speed:2180rpm

4.5 Storm32 BGC 32Bit 3-Axis Brushless Gimbal Controller board V1.32 DRV8313 Motor Driver

The Storm 32 has a 32Bit microprocessor which operates at 72MHz and provides sufficient power to your DIY gimbal assembly. The 32Bit microprocessor and firmware combined provide an incredible range of programming functions. The onboard output options provide a multitude of connectivity options including PWM, PPM, IR LEDs, joystick, button, 7 x auxiliary ports which serves as inputs and/or outputs for PWM/Sum-PPM signals. The Storm 32 also supports the connection of a range of satellite receivers including Futaba S-Bus and Spektrum types.

4.6 2208 80KV Gimbal Brushless Motor

The 2208/80KV Gimbal Brushless Motor comes with a servo style connector making it easy to connect with gimbal controllers. As the gimbal motor has to survive too much drags in its operational life hence it equips flexible cable for nice and efficient balancing. In total, this wire and connector assembly is a Plug-N-Play system. 2208 80KV Gimbal Brushless Motor is the perfect size for a GoPro class camera (100-200g). It has superb Fit and Finishes. It is engineered to have a lean profile for easy integration into your set-up. 2208 80KV Gimbal Brushless Motor has preloaded bearings for the slop-free precision mount.

4.7. NodeMCU [ESP8266]:

Ai Thinker NodeMCU-ESP8266 is an open-source firmware and development kit that helps you to prototype or build IoT products. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which is based on the ESP-12 module. The firmware uses the Lua scripting language. It is based on the eLua project and built on the Expressive Non-OS SDK for ESP8266.

Features: WIFI module: ESP-12E,Processor: ESP8266,CP2102 ChipBuilt-in Flash: 32MbitAntenna: Onboard PCB antenna, Peripheral interface: UART/SPI/I2C/SDIO/GPIO/ADC/PWM,WiFi protocol: IEEE

802.11 b/g/n Frequency range: 2.4G ~ 2.5G (2400M ~ 2483.5M), WIFI mode: Station / SoftAP / SoftAP+Station, Power supply: 5V,Logic level: 3.3V

4.8 DC Motor

An Electric DC motor is a machine which converts electric energy into mechanical energy. A machine that converts DC power into mechanical power is known as a DC motor. The working of DC motor is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force. The direction of mechanical force is given by Fleming's Left- hand Rule and its magnitude is given by F = BIL Newton. DC motors are seldom used in ordinary applications because all electric supply companies furnish alternating current. for special applications such as in steel mills, mines and electric trains, it is advantageous to convert alternating current into direct current in order to use dc motors. The reason is that speed/torque characteristics of d.c. motors are much more superior to that of a.c. motors. Therefore, it is not surprising to note that for industrial drives, d.c. motors are as popular as 3-phase induction motors.

4.9 Ball bearings

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least three races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other

4.10 Differential mechanism

This is made with the help of a ball bearing which is pivoted on the body of the rover and supported by two pistons on the either side of the ball bearing outer mount. The another end of the piston is mounted at the each arms of the rover.

4.11 Polycarbonate:

The body is made of polycarbonate material. Polycarbonate is commonly used in eye protection, as well as in other projectile-resistant viewing and lighting applications that would normally indicate the use of glass, but require much higher impact-resistance

V. TESTING RESULTS

This is the rover which was assembled and tested

This is the gimbal assembled and tested

VI. CONCLUSION

The rover can push or pull regardless of wheel direction, move laterally left or right, rotate 360 degrees in place, and also turn in an arch. The gimbal stabilization system ensures a stable image by blocking motion-related vibrations before they are transferred to the camera lens axes. Thus combining the both systems can gives a mobile stable image recording in various situation. This is targeted in cinema field and emergency purposes

REFERENCES

[1] J.M. Sullivan, "Evolution or Revolution? The Rise of UAVs", IEEE Tech. and Soc. Mag., vol. 25, no. 3, pp. 43-49, 2006

[2] J.L. Marins, X. Yun, E.R. Bachmann, R.B. McGhee, M.J. Zyda An Extended Kalman Filter for Quaternion-Based Orientation Estimation Using MARG Sensors. International Conference on Intelligent Robots and Systems, Maui, Hawaii, USA,

[3] G. Baldwin, R. Mahony, J. Trumpf, T. Hamel, T. Cheviron Complementary Filter Design on the Special Euclidean Group SE.9th European Control Confrerence on behalf of the EUCA, Kos, Greece, 2007.