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"BODY ON FRAME SPYDER ROBOT"

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Abstract: A hexapod robot is a type of multi-legged robot with six legs that is designed to mimic the locomotion and movement patterns of insects or spiders. The need for hexapod robots arises from their ability to navigate and interact with their environment in ways that traditional wheeled or tracked robots cannot. Hexapod robots can be used in many applications, including educational tools for teaching robotics and programming concepts, entertainment and hobby robotics, and even practical applications such as search and rescue operations in rugged terrains where wheeled or tracked robots cannot operate. The complexity of hexapod robots can vary significantly, ranging from simple hobbyist projects to advanced research platforms. Advances in robotics and control systems have led to the development of hexapods with impressive capabilities such as walking on uneven surfaces, climbing stairs, and even performing complex tasks requiring manipulation and object interaction. Biomechanics are at the heart of the biomimetic embodiment of a hexapod robot because legs are the most important part of the robot and they have to follow various locomotion patterns dictated by the locomotion control system.

I. INTRODUCTION

In perilous environments such as war zones and high-altitude areas where human safety is at stake, finding innovative solutions to prioritize human well-being becomes crucial. We now introduce the Spyder Robot – not merely a security measure, designed to step into roles where human presence may be impractical. This robotic marvel goes beyond conventional surveillance; it can serve as the eyes and ears of observers. Think of the Spyder Robot as a virtual ally, a stealthy companion ready to be strategically deployed to safeguard national security interests . This isn't just technological advancement; it's a leap forward in our approach to security and surveillance, providing a reassuring presence in the most challenging and perilous terrains. With its analytical acumen, instant reporting capabilities, and adaptiveness, the Spyder Robot emerges as more than just a machine – it's a steadfast detector, ensuring the safety and security of individuals in situations where a human touch might be too risky.

A hexapod robot is a mechanical vehicle that walks on six legs, providing a great deal of flexibility in movement and stability. These robots are often controlled by gaits, allowing them to move forward, turn, and navigate uneven terrain. Hexapod designs vary in leg arrangement and can be biologically inspired by insect locomotion. Research has aimed to transfer knowledge from insect biology into hexapod walking robots, leading to bio-inspired and compliant hexapod designs. Hexapod robots have been used for various tasks, including desert ant-like navigation, testing biological theories about insect locomotion, and even humanitarian demining. The similarity of some hexapod robot models to their biological counterparts, such as stick insects, allows for the transfer of knowledge from insect biology into robotics.

II. PROPOSED SYSTEM ARCHITECTURE

The hexapod robot's block diagram comprises crucial components for seamless operation. The STM32 microcontroller acts as the central processing unit, managing commands and sensor inputs. Wireless control is facilitated by a Bluetooth module, while eighteen servo motors are orchestrated by an 12-channel servo driver for precise and synchronized leg movements. A buck converter regulates the power supply, ensuring efficient energy management. Through PWM signals, the STM32 communicates with the servo driver, translating user commands received via Bluetooth into coordinated leg actions.

This integrated system offers versatility and responsiveness to the hexapod, combining the computational power of the STM32, wireless communication capabilities of the Bluetooth module, precise motion control enabled by eighteen servo motors, and efficient power regulation through the buck converter. The hexapod robot becomes an agile and controllable platform, suitable for a variety of applications. Mobile device is used to provide instructions and controllability over the robot

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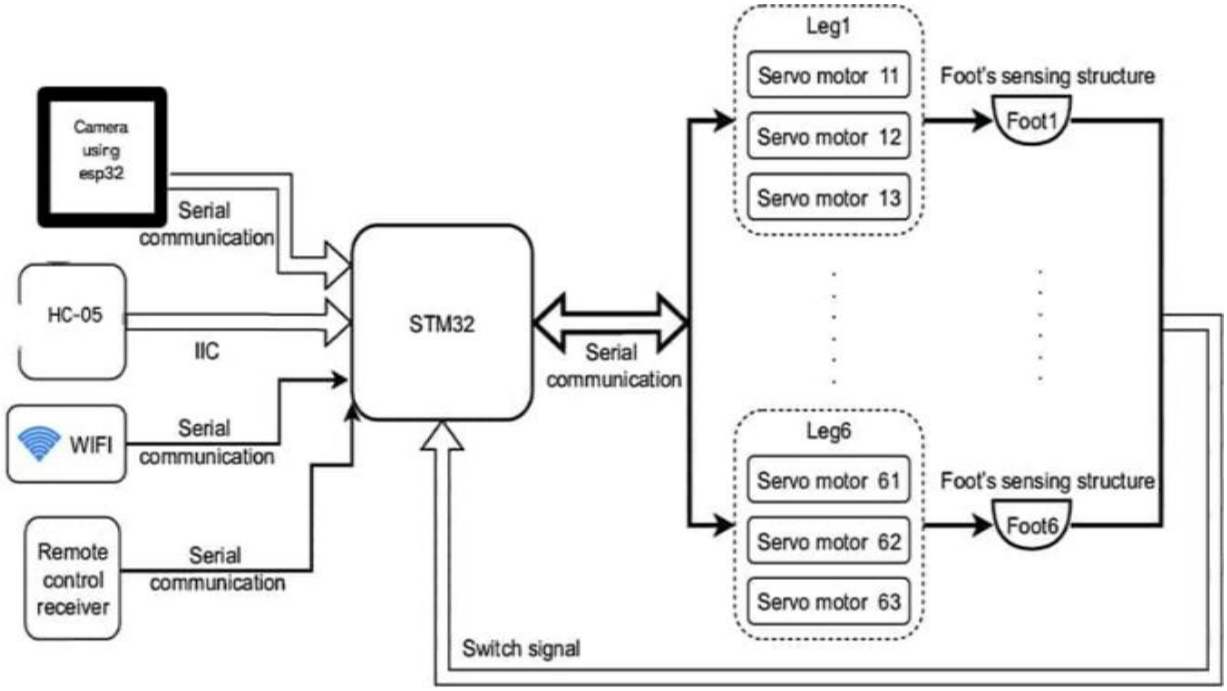

Fig. 1: Block Diagram

HARDWARE REQUIREMENTS

1. STM32

The STM32 Blue Pill, also known as STM32F103C8T6, is a highly cost-effective development board that has gained popularity in the embedded systems and microcontroller communities. It is based on the ARM CortexM3 core, operating at a frequency of 72 MHz, and offers a 32-bit architecture, 64KB of flash memory, and 20KB of RAM. Overall, the STM32 Blue Pill has established itself as a compelling choice for engineers, students, and hobbyists looking to work with a feature-rich microcontroller platform at an affordable price point. Its robust capabilities, extensive community support, and compatibility with the Arduino IDE make it an attractive option for those seeking a balance between performance and cost-effectiveness.

2. HC-05 BLUETOOTH MODULE

The HC-05 is a popular Bluetooth module known for its ability to add two-way (full-duplex) wireless functionality to various projects. It is a class 2 Bluetooth module designed for transparent wireless serial communication and is pre-configured as a slave Bluetooth device. The module can be easily paired with microcontrollers as it operates using the Serial Port Profile (SPP). The module communicates using the USART at a baud rate of 9600, making it easy to interface with microcontrollers. The HC-05 is a versatile and user-friendly Bluetooth module that offers a cost-effective solution for wireless communication in electronic projects.

3. ESP 32 with cam

The ESP32 with a camera refers to a versatile microcontroller module, the ESP32, which integrates both Wi-Fi and Bluetooth capabilities, paired with a camera module. This combination enables developers to create compact and cost-effective solutions for various applications, including IoT projects, surveillance systems, and image processing applications. The ESP32's dual-core processor and wireless connectivity options make it suitable for tasks such as capturing, transmitting, and processing images in real-time.

4. PCA9865 SERVO DRIVER

The PCA9685 is a 16-channel, I²C-bus-controlled servo driver that offers precise control over servo motors. The PCA9685 operates with a supply voltage range of 2.3 V to 5.5 V and is compatible with various microcontrollers, including Arduino and Raspberry Pi. The PCA9685 is a versatile solution for controlling multiple servos in various applications, such as robotics, automation, and lighting control systems. Its compact size, low power consumption, and ease of use make it a popular choice for designers and engineers working with servo motors.

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5. XL4016E1 BUCK CONVERTER

The XL4016E1 is a popular DC-to-DC step-down converter that is widely used in various electronic projects. It is a complete buck converter module that is readily available and easy to use. When using the XL4016E1 circuit, some precautions should be taken, such as avoiding exceeding the maximum input voltage or output current, using a heat sink for the IC if the power dissipation is high. The XL4016E1 module is a cost-effective solution for step-down voltage regulation and is widely available in online markets.

6. HX-2S-JH20

The HX-2S-JH20 is a lithium battery protection board for 18650 battery packs. It is equipped with a balance function and overcharge protection, making it suitable for applications requiring safe and efficient battery management. The HX-2S-JH20 is capable of handling an upper working current of 10A and an upper limit instantaneous current of 20A. It features overcharge protection with an overcharge voltage range of 4.25-4.35V.

7. MG996

The MG996 is a standard size servo motor known for its high torque and reliability. The MG996 servo motor is equipped with metal (brass and aluminium) gears, providing durability and efficient power transmission. It operates on an analog drive and is compatible with a voltage range of 4.8V to 6V. It offers a torque of up to 13kg/cm 4.8V. These servos are commonly used in various applications, including robotic arms, steering controls, and other projects requiring high torque and precise movement. Precautions to ensure that the power supply can meet the required voltage and current specifications to avoid performance issues.

8. 18650 Battery

The 18650 battery is a popular lithium-ion rechargeable battery format, known for its high energy density and reliability. These batteries are commonly used in a variety of devices, including laptops, flashlights, and electric vehicles. The "18650" designation is derived from its dimensions, with the first two digits representing its diameter, the next two digits representing its length, and the final zero indicating a cylindrical battery.

III. CONCLUSION

In summary, the hexapod robot is like a tech-savvy companion, boasting a cool set of features that make it stand out in the robotic world. Imagine it as having a smart brain (the STM32 microcontroller) that efficiently processes information and executes commands, coupled with a wireless heart (Bluetooth module) that lets you control it from a distance. Its eighteen servo motors, choreographed by a dedicated driver, work together like a dance troupe, enabling graceful and precise leg movements. Think of it as having a reliable energy manager (buck converter) that ensures the hexapod stays energized for all its adventures. Altogether, this hexapod isn't just a robot; it's a high-tech sidekick ready for a multitude of tasks, from exploration to surveillance, making it a versatile and user-friendly companion in the world of robotics.

IV. RESULT ANALYSIS

To prepare a working Hexapod robot prototype which works using and android app. To be able to relay the video feed to the user. The robot is designed to offer smooth movement with good speed and a simple control system to make it easy for the user to steer and control the robot. The spyder robot is designed to have the three degrees freedom of movement as a biological spider except for its wall climbing abilities, allowing it to navigate through tough environments for the best mobility.

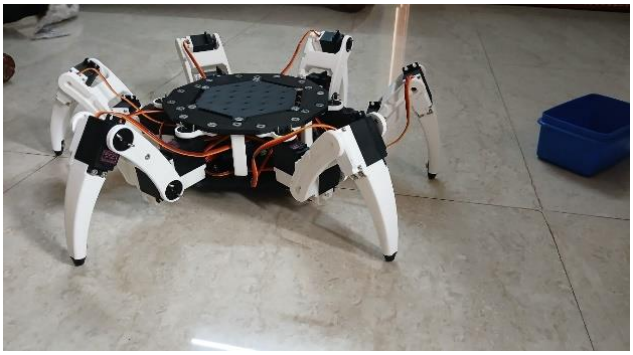

Fig. 2: Project Prototype

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REFERENCES

[1] S. Fei, Y. Chen, H. Tao and H. Chen, "Hexapod Robot Gait Switching Based on Different Wild Terrains," 2023 IEEE 12th Data Driven Control and Learning Systems Conference (DDCLS), Xiangtan, China, 2023, pp. 1325-1330, Doi: 10.1109/DDCLS58216.2023.10166077.

[2] K. Ajith and A. R R, "Design of Hexapod Robot with Adaptive Gait Transition on Rough Terrain," 2023 International Conference on Control, Communication and Computing (ICCC), Thiruvananthapuram, India, 2023, pp. 1-6, Doi: 10.1109/ICCC57789.2023.10165370.

[3] N. Ukani, S. Chakole, S. S. B. Diwan, S. S. Kawale and S. K. Hedau, "Developing Hexapod Robot," 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2020, pp. 1181-1184, Doi: 10.1109/ICACCS48705.2020.9074235.

[4] G. Tanaka, T. Takamura, Y. Shimura, K. Motegi and Y. Shiraishi, "Development of Simulator and Analysis of Walking for Hexapod Robots," 2019 58th Annual Conference of the Society of Instrumentand Control Engineers of Japan (SICE), Hiroshima, Japan, 2019, pp. 1594-1599, Doi: 10.23919/SICE.2019.8859942.

[5] J. Coelho et al., "Study of the locomotion of a hexapod using Coppelia Sim and ROS," 2021 International Conference on Computers and Automation (CompAuto), Paris, France, 2021, pp. 109-116, Doi:10.1109/CompAuto54408.2021.00027.

[6] M. I. Uddin, M. S. Alamgir, J. Chakrabarty, M. I. Hossain and M. A. Abdulla Samy, "Multitasking Spider Hexapod Robot," 2019 IEEE International Conference on Robotics, Automation, Artificial intelligence and Internet-of-Things (RAAICON), Dhaka, Bangladesh, 2019, pp. 135-140, Doi:10.1109/RAAICON48939.2019.58

[7] M. Yang and X. Zhu, "Research on smart amphibious hexapod robots," 2021 IEEE Conference on Telecommunications, Optics and Computer Science (TOCS), Shenyang, China, 2021, pp. 897-900, Doi: 10.1109/TOCS53301.2021.9688619.

[8] J. Kon and F. Sahin, "Gait Generation for Damaged Hexapods using a Genetic Algorithm," 2020 IEEE 15th International Conference of System of Systems Engineering (SoSE), Budapest, Hungary, 2020, pp.451-456, Doi: 10.1109/SoSE50414.2020.9130561.

[9] S. I. Beaber, M. A. Kamel, A. S. Zaghloul and W. M. Hussein, "Trajectory Generation of Hexapod Robots Based on Genetic Algorithm," 2023 Intelligent Methods, Systems, and Applications (IMSA), Giza, Egypt, 2023, pp. 604-609, Doi: 10.1109/IMSA58542.2023.10217728.

[10] S. Muslimin and D. Istardi, "Inverse Kinematics Analysis for Motion Prediction of a Hexapod Robot," 2018 International Conference on Applied Engineering (ICAE), Batam, Indonesia, 2018, pp. 1-5, Doi: 10.1109/INCAE.2018.8579402.

[11] J. PR, L. Rachaputi, J. Yerramelli, K. Rajesh and P. Ratnakaram, "Performance analysis of Hexapod leg with different controllers," 2021 6th International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India, 2021, pp. 139-145, Doi: 10.1109/ICCES51350.2021.9489127.

