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Autonomous AI Sentry Turret with Area Surveillance

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Abstract: ***This paper presents an AI-driven sentry turret about to be designed for real-time area surveillance and threat detection. Improving the safety and security of critical places has made the development of autonomous security systems essential. The AI-driven sentry turret presented in this is intended to make for threat identification and real-time area observation. The system, which is equipped with advanced sensors, computer vision, and mobility capabilities, patrols designated areas automatically, identifying potential intruders and responding to hazards. The use of machine learning techniques allows the turret to increase its accuracy in detecting various objects and behaviors over time. The project intends to provide a scalable and effective solution for premises security, decreasing the need for human intervention in hazardous or high- security areas.***
Keywords: autonomy, surveillance, security, ai, monitoring, detection.

I. INTRODUCTION

Autonomous technology's quick development has transformed many industries, most notably security and surveillance systems. There is a rising need for intelligent, dependable, and scalable security solutions that can function with little assistance from humans due to the escalating threats to private properties, public areas, and key infrastructure. AI-powered sentry turrets and other autonomous security systems are set to be crucial in tackling these issues. Manual patrols and static CCTV cameras are examples of classic security techniques that frequently have drawbacks including limited coverage, slow reaction times, and a heavy reliance on human monitoring. In order to address these issues, there has been a lot of interest in incorporating computer vision, robotics, and artificial intelligence (AI) into security systems. The goal of our research is to create an autonomous artificial intelligence sentry turret with sophisticated mobility and surveillance features. This turret system is intended to watch a specified region on its own, recognize possible threats, and react instantly. The sentry turret can patrol areas without continual human supervision by combining autonomous navigation and real-time facial recognition, providing a scalable and effective way to improve property protection. The system design, implementation specifics, and performance assessment of the AI-driven sentry turret are presented in this study. We also evaluate the turret system's efficacy against other security options, emphasizing its benefits in terms of autonomous mobility, real-time detection, and adaptability.

II. SYSTEM ARCHITECHTURE

A. Camera Programming and AI Integration

The main component of the turret's object detection and tracking capabilities is the HuskyLens AI camera. It is appropriate for real-time security applications since it has already been taught to detect the presence of people and other objects. Based on preset criteria, the camera's integrated machine learning algorithms enable it to distinguish between authorized persons and possible intruders. The HuskyLens detection data is processed by the Arduino Uno R4, which then converts it into commands for turret movement. In order to stay focused on moving targets, the system continuously assesses the surroundings and modifies the tracking parameters. To improve accuracy and reduce false positives, threshold-based decision algorithms were also used. Features for facial recognition will be added in the future to further improve object classification.[2]

Fig.1 HuskyLens

B. Motors and Movement Mechanism

BO motors provide the turret's mobility, allowing for precise tracking of intruders through 360-degree horizontal rotation and vertical tilting. By ensuring precise and fluid movement, the motor control system lowers tracking lag and jitter. Power distribution is controlled by the L298N motor driver module, guaranteeing steady functioning under a range of circumstances. The motors' speed and direction were effectively controlled by use of pulse width modulation (PWM) techniques. To make sure the turret responds quickly to threats it detects, the moving mechanism was put through a rigorous testing process for durability, tracking accuracy, and response time. Stepper motors for finer control and autonomous repositioning capabilities are possible future improvements.[2][3]

Fig.2 Mecanum wheels

Fig.3 BO Motors

C. Wireless Alert System

To give security staff real-time notifications, a wireless communication system was created. To send notifications with detection time, target movement information, and photos taken with the HuskyLens, the system combines Wi-Fi and Bluetooth components. To ensure prompt action, these notifications are routed to a specialized security system, web dashboard, or smartphone application. Rapid threat assessment was made possible by the communication protocol's optimization to guarantee low-latency data transmission. Integration with cloud-based monitoring platforms for automated alert escalation and remote access may be part of future enhancements.[8]

D. Chassis and Cover Designing

To guarantee a sturdy yet lightweight design, CAD modeling software was used to create the turret's chassis and upper cover. Stability, simplicity of assembly, and environmental protection of electronic components are given top priority in the design. Rapid iteration and accurate modifications were made possible by the final prototype's 3D printing. The base offers structural support for the turret's rotating mechanism, while the upper cover protects delicate parts from damage, moisture, and dust. Slots for ventilation were included to keep internal circuits from overheating. Future enhancements might include modular mounting choices for various terrains and weatherproofing for outdoor deployment.

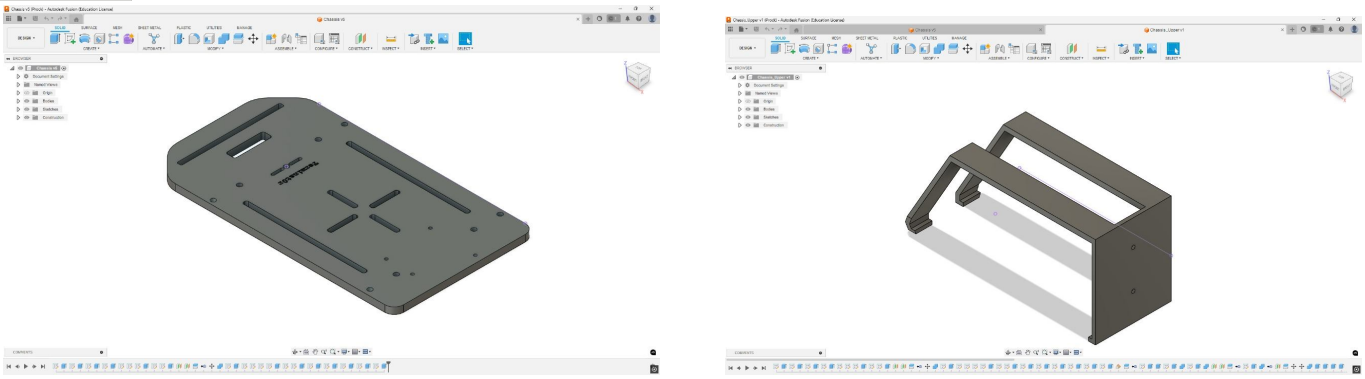

Fig.4 Turret Chasis and upper cover designing

E. System Workflow

To guarantee a sturdy yet lightweight design, CAD modeling software was used to create the turret's chassis and upper cover. Stability, simplicity of assembly, and environmental protection of electronic components are given top priority in the design. Rapid iteration and accurate modifications were made possible by the final prototype's 3D printing. The base offers structural support for the turret's rotating mechanism, while the upper cover protects delicate parts from damage, moisture, and dust. Slots for ventilation were included to keep internal circuits from overheating. Future enhancements might include modular mounting choices for various terrains and weatherproofing for outdoor deployment.

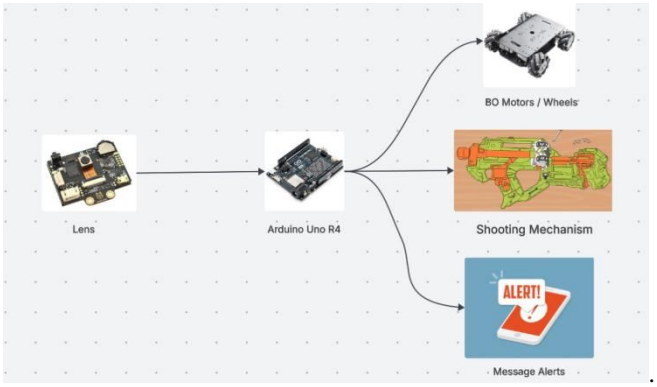

Fig.5 Workflow

F. Testing and Performance Evaluation

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III. IMPLEMENTATION AND PROTOTYPE

A methodical approach to the design, construction, and testing of a prototype that incorporates cutting-edge surveillance, detection, and response capabilities is required for the Autonomous AI Sentry Turret's deployment. The main elements of the implementation process, such as software development, hardware selection, and prototype testing, are described in this section.

The turret will be made up of a number of crucial hardware parts, each chosen for its capacity to perform particular tasks:

1) *The HuskyLens AI Module:* The central processing unit for object identification and classification will be the HuskyLens AI module. This module will be configured to identify both allowed individuals and possible dangers.
2) *Omnidirectional wheels and high-torque motors:* To guarantee mobility, the turret will have omnidirectional wheels and high-torque motors that allow for nimble movement over a variety of surfaces. When dangers are discovered, its design enables prompt repositioning[6].

3) *Non-Lethal Round Mechanism:* The turret design will incorporate a non-lethal round deployment mechanism that will divert and discourage invaders without causing irreversible damage.
4) *Power Supply:* To ensure prolonged operational capabilities, a rechargeable battery pack will supply the required power for all components. When the turret is not actively patrolling, the power management system will monitor energy consumption and transition to low-power modes.[6]

Fig.6 Autonomous Sentry Turret Design

To guarantee performance and dependability, the Autonomous AI Sentry Turret prototype will go through extensive testing:
Initial Component Testing: The functionality and integration of each hardware component will be examined separately. This entails evaluating the turret's mobility, the AI module's accuracy, and the camera's video quality. System Integration Testing: To assess how well the turret detects and tracks intruders, extensive system testing will be carried out after all components have been integrated. To evaluate the efficacy of the AI algorithms and response mechanisms, this will entail simulating several infiltration situations. Field Testing: Following laboratory testing, the prototype will be put to the test in a controlled outside setting. The performance of the turret will be evaluated in this step under dynamic settings, such as changing lighting and environmental obstructions. Feedback and Iteration: To pinpoint areas that want improvement, data gathered during testing will be examined. To improve the turret's performance and usability, input from early testers and users will be integrated into later revisions of the design.[2]

IV. CONCLUSION

Ultimately, the Autonomous AI Sentry Turret aims not only to deter potential intruders but also to provide a safer environment for personnel and assets. As security challenges evolve, this innovative solution stands poised to meet the demands of modern security applications, paving the way for a more secure future.

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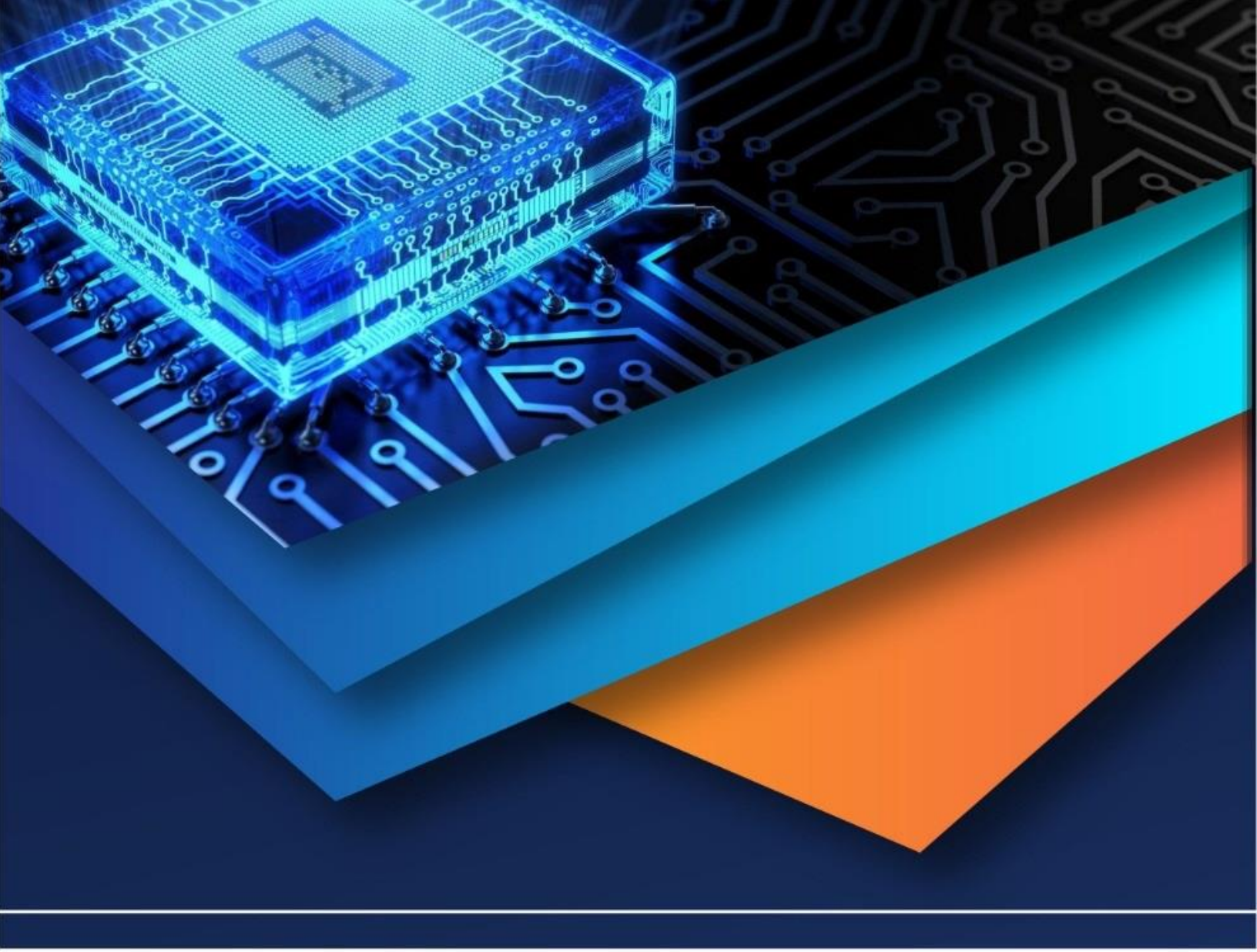
REFERENCES

[1] Louali, R., Negadi, D., Hamadouche, R., & Nemra, A. (2022). Design of a Vision Based Autonomous Turret. Journal of Automation, Mobile Robotics and Intelligent Systems, 72-77
[2] Shue, S., Hargrove, C., & Conrad, J. (2012, March). Low cost semi-autonomous sentry robot. In 2012 proceedings of IEEE southeastcon (pp. 1-5). IEEE
[3] Colon, H., Horton, A., Steighner, K., & Yielding, N. (2010). Autonomous Turret. EE4914 *Group, 17*.
[4] Demski, P., Grzejszczak, T., Jędrasiak, K., & Mikulski, M. (2013). Automatic targeting sentry turret for distributed systems. In Vision Based Systemsfor UAV Applications (pp. 47-55). Heidelberg: Springer International Publishing
[5] Ahmad, H., Ali, S. M., Sheikh, U. A., Murtaza, Z., & Rizwan, M. (2016, November). Design and manufacturing of a low-cost 2-DOF autonomous sentry gun. In 2016 2nd International Conference on Robotics and Artificial Intelligence (ICRAI) (pp. 196-201). IEEE.
[6] Alcala, R. R., Arceo, Z. G., Baterisna, J. N., Morada, J. O., Ramirez, J. O. D., & Tolentino, R. E. (2020, June). Design and implementation of body wearable device and oculus rift controlled panning and aiming sentry gun turret. In 2020 4th International Conference on Trends in Electronics and Informatics (ICOEI)(48184) (pp. 871-876). IEEE.
[7] Kashif, M., Arslan, M., Chakma, R., Banoori, F., Al Mamun, A., & Chakma, G. L. (2018). Design and implementation of image capture sentry gun robot. In MATEC Web of Conferences (Vol. 160, p. 06007). EDP Sciences
[8] Gagliardi, A., & Gagliardi, D. (2013). Remote/Autonomous Sentry Gun Platform.
[9] Louali, R., Negadi, D., Hamadouche, R., & Nemra, A. (2022). Design of a Vision Based Autonomous Turret. Journal of Automation, Mobile Robotics and Intelligent Systems, 72-77.
[10] Camarato, S. J., Jaramillo, N., & Young, M. A. Autonomous NERF Turret with Facial Recognition (ANT-FR).



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