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AI Based Object Detection with Live Tracking

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Abstract: *Our case-study titled "AI-based Object Detection with Live Tracking" combines advanced technologies to create a comprehensive system for real-time object detection and location tracking. This abstract summarizes the key components and functionalities of the project. The project leverages the ESP32-CAMmodule for object detection, utilizing artificial intelligence algorithms to recognize and classify objects within a captured video stream. This AI-based approach allows for efficient and accurate detection of various objects in different environments. The ESP32-CAM's capabilities make it an ideal platform for on-device processing, ensuring low latency and real-time performance. In addition to object detection, the system incorporates a GPS module (specifically, the NEO-6M) for precise location tracking. This module enables the system to determine its exact geographical coordinates, providing essential location data for tracking purposes. Integration with the GPS module ensures that the system can accurately pinpoint the position of detected objects in outdoor settings. Furthermore, the project incorporates the SIM800 module to enable live location updates via SMS. Upon detecting an object and determining its location, the system utilizes the SIM800 module to send real-time SMS notifications containing the object's coordinates to a designated phone number. This feature enhances the system's usability by allowing users to receive immediate alerts and track objects remotely. Overall, the combination of AI-based object detection, GPS based location tracking, and live SMS notifications makes this project a versatile solution applicable to various scenarios such as security surveillance, wildlife monitoring, or asset tracking. The system's integration of ESP32-CAM, GPS NEO-6M, and SIM800 modules showcases an innovative approach to combining multiple technologies for effective and practical real-time object detection and tracking applications. The abstract highlights the project's core functionalities and sets the stage for further detailed exploration and implementation of this integrated system*

Keywords: Artifical Intelligence, Camera, GPS, GSM, SMS

I. INTRODUCTION

Our research titled "AI-Based Object Detection with Live Tracking" integrates cutting-edge technologies to create a sophisticated system for real-time object detection and live location tracking. Leveraging the ESP32-CAM microcontroller, the project incorporates artificial intelligence (AI) algorithms for object detection. The ESP32-CAM's capabilities in image processing and machine learning enable it to identify various objects within its field of view. This functionality opens up possibilities for diverse applications, such as security monitoring, inventory management, or smart home automation. Complementing this is the integration of a GPS module, specifically the NEO-6M, which provides accurate location data. The GPS module enables the system to continuously track its own position, facilitating live location updates. Additionally, the SIM800 module is utilized for communication purposes, allowing the device to send live location information via SMS to a predefined phone number. This feature enhances the project's practicality, enabling users to remotely monitor the device's whereabouts in real-time. By combining these components, the project demonstrates a holistic approach to AI-driven object detection and live tracking, underscoring the increasing intersection of AI and IoT technologies. The convergence of these technologies not only showcases their individual capabilities but also highlights their synergistic potential in creating intelligent and responsive systems. This introductory overview sets the stage for a detailed exploration of the project's design, implementation, and potential applications, emphasizing its innovation in the realm of smart devices and IoT solutions.

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II. PROPOSED BLOCK DIAGRAM

Our idea integrates various technologies to achieve real-time object detection and tracking coupled with live location updates. At the core of the system is the ESP32-CAM, a microcontroller with built-in Wi-Fi and camera functionalities, serving as the primary platform for object detection. This module captures live video frames and employs an AI-based algorithm, possibly leveraging deep learning models like YOLO (You Only Look Once), to detect and classify objects within the camera's view.

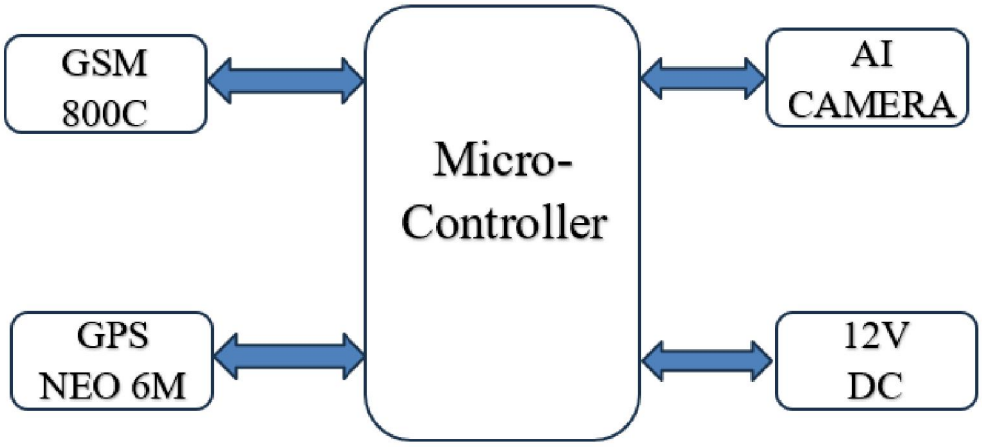

Fig. 1. Proposed block diagram

To enhance the functionality of the system, GPS NEO-6M is utilized for accurate location tracking. This GPS module communicates with the ESP32-CAM, providing continuous updates of the device's current coordinates. The combination of object detection and GPS data enables the system to not only identify objects in the environment but also correlate their positions with geographic coordinates.For real-time communication of location data, the SIM800 module is integrated into the system. This module enables the ESP32-CAM to send SMS notifications containing live location updates to a designated phone number. By utilizing the cellular network, the system ensures reliable transmission of location information even when Wi-Fi connectivity is unavailable.The block diagram of the project illustrates the interconnected components and their roles. The ESP32-CAM module acts as the central processing unit, interfacing with the camera for object detection, the GPS module for location tracking, and the SIM800 module for SMS communication. The camera captures video frames, which are processed by the object detection algorithm running on the ESP32-CAM. Simultaneously, the GPS module retrieves location data, which is then integrated with the object detection results. Finally, the SIM800 module facilitates the transmission of live location updates to a user's phone via SMS.This integrated approach enables real-time monitoring and tracking of detected objects along with the continuous transmission of precise location information. The system can be deployed in various applications such as security surveillance, wildlife monitoring, or asset tracking where the combination of AI-based object detection and live tracking capabilities is essential.

III. METHODOLOGY USED

Ouridea on "AI based Object Detection with Live Tracking" combines hardware components and software algorithms to achieve real-time object detection and location tracking. The methodology employed in this project can be outlined as follows:

1. Hardware Setup:

- ESP32-CAM: The ESP32-CAM module is utilized for capturing live video feed and performing real-time object detection using its integrated camera and processing capabilities.

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- GPS NEO-6M Module: This module is integrated into the system to acquire accurate geographical coordinates (latitude and longitude) of the device's current location.
- SIM800 Module: The SIM800 module is employed for GSM communication, enabling the system to send SMS messages containing live location updates to a designated phone number.

2. Object Detection:

- Machine Learning Model: Develop or utilize a pre-trained machine learning model (such as YOLO, SSD, or MobileNet) for object detection. The ESP32-CAM captures frames from its camera and processes them through this model to identify objects within the frame.
- Integration with ESP32-CAM: Implement the object detection model on the ESP32 platform using libraries like TensorFlow Lite for Microcontrollers or Edge Impulse. This allows the ESP32 to perform inference locally and identify objects in real-time.

3. Live Tracking System:

- GPS Data Acquisition: Configure the GPS NEO-6M module to retrieve accurate GPS coordinates periodically.
- Location Data Processing: Integrate the GPS module's output with the ESP32-CAM system to embed location information into the captured video stream or associated metadata.
- SMS Sending with SIM800: Develop a function to format the current GPS coordinates into a user-friendly format (e.g., latitude, longitude) and utilize the SIM800 module to send SMS messages containing this location information to a specified phone number.

4. Software Implementation :

- Firmware Development: Write firmware for the ESP32-CAM that orchestrates the object detection process, GPS data retrieval, and SMS sending functionality.
- Code Optimization: Ensure efficient memory usage and processing speed given the constraints of the ESP32 microcontroller.
- Error Handling and Robustness: Implement error handling mechanisms to manage connectivity issues, object detection failures, or GPS signal disruptions gracefully.

5. Testing and Deployment:

- Integration Testing: Validate the entire system by deploying it in various scenarios to ensure accurate object detection and reliable location tracking.
- User Interface : Develop a simple interface (e.g., web interface or mobile app) for users to receive SMS notifications and visualize the live tracking data.

6. Documentation and Maintenance:

- User Manual: Create comprehensive documentation detailing the setup, usage instructions, and troubleshooting steps for end users.
- Maintenance Plan: Outline a maintenance strategy for updating machine learning models, firmware, or any associated components over time.

IV. SYSTEM OVERVIEW

The proposed system i.e .“AI BASED OBJECT DETECTION WITH LIVE TRACKING” consists of several sensors and controller which are listed below with the overview of their specification–

- NodeMCU(Microcontroller)
- GSM 800C
- GPS NEO-6M
- ESP32 CAM

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NODEMCU V1.0

TheNodeMCUESP8266isaversatileandwidely-useddevelopmentboardrenownedforitscompactsizeandpowerfulfeatures.Itservesasanessentialtoolinthe,IoT(Internet ofThings)andembeddedsystemsdevelopment.

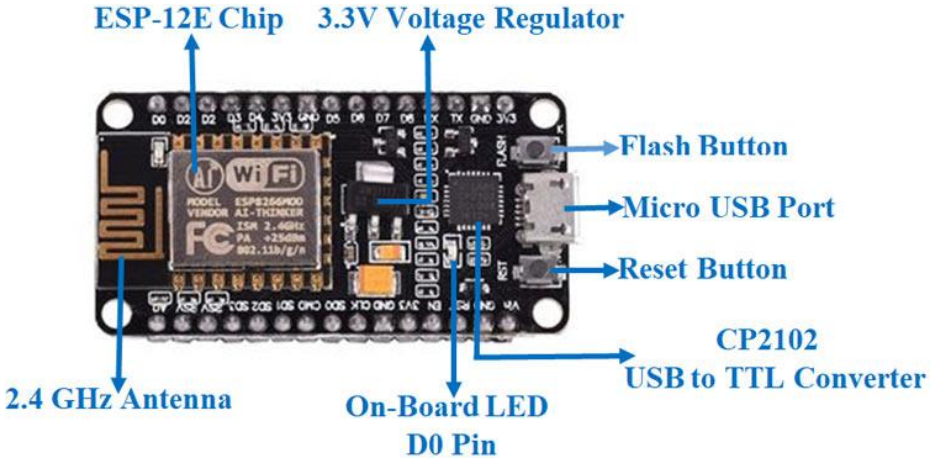

Fig.2.Systemcomponent–NODEMCUESP8266

TheNodeMCUESP8266isanintegrateddevelopmentboardbuiltaroundtheESP8266microcontrollermodule,designedt ofacilitatetherapidprototypingofIoTprojectsandembeddedsystems.Atitscore,theESP8266microcontrollerboastsa32-bit Tensilica Xtensa LX106 processor, clocked at speeds of up to 80MHz (with the possibility of overclocking to160MHz),renderingitcapableofhandlingawiderangeoftaskswithremarkableefficiency.

One of the most notable features of the NodeMCU ESP8266 is its built-in Wi-Fi connectivity, which enables seamlesscommunicationwithlocalnetworksandtheinternet.ThisfunctionalityallowsdevicesbuiltwiththeNodeMCUE SP8266tointeractwithonlineservices,exchangedatawithremoteservers,andparticipateinIoTecosystems.Theboardsup portsthe802.11b/g/nWi-Fistandards,ensuringcompatibilitywithmostmodernwirelessnetworks.

In terms of connectivity, the NodeMCU ESP8266 provides a plethora of GPIO (General Purpose Input/Output) pins, offeringflexibility for interfacing with various sensors, actuators, and peripheral devices. These GPIO pins support digitalinput/outputoperations,analoginputmeasurements,andPWM(PulseWidthModulation)outputcontrol,enabling awiderangeofapplications.

The NodeMCU ESP8266 board also features a USB-to-Serial interface chip, typically the CH340 or CP2102, whichfacilitates easy programming and debugging via a standard USB connection. This interface allows developers to uploadfirmware, monitor serial output, and interact with the microcontroller directly from their computer, streamlining thedevelopmentprocess.

GPS NEO-6M-

One of the global positioning system (GPS) devices utilizes data from satellites to locate a specific point on the Earth in a process named trilateration.

Meanwhile, a GPS receiver measures the distances to satellites using radio signals to trilateration. And trilateration is similar to triangulation, which measures angles, depicted in this illustration (Tim Gunther, 2020). GPS modules contain tiny processors and antennas that directly receive data sent by satellites through dedicated RF frequencies.

From there, it'll receive timestamp from each visible satellites, along with other pieces of data. If the module's antenna can spot 4 or more satellites, it's able to accurately calculate its position and time.The four well-known Global Navigation Satellite System include GPS, BDS(Beidou), GLONASS and GALILEO four satellite navigation systems.

The earliest appeared in the United States is GPS (Global Positioning System), which is the most complete technology at this stage. BDS, GLONASS and GALILEO have become the other largest satellite navigation systems in the world and are currently in the process of modernization.

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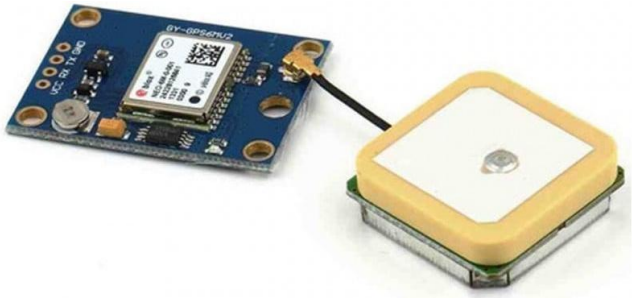

Fig.3.Systemcomponent–GPS NEO 6M

GSM MODULE–

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.These modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computers. A GSM modem can be a dedicated modem device with a serial, USB, or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. A GSM module works by connecting to the GSM network through a SIM card. The SIM card provides the module with a unique identification number, which is used to identify the device on the network. The GSM module then communicates with the network using a set of protocols, which allows it to send and receive data. The GSM network is a digital cellular network that uses a set of protocols to enable communication between devices.

The network is divided into cells, which are each serviced by a base station. The base station communicates with the devices in its cell, and the cells are interconnected to form a network. The GSM module plays a crucial role in the communication between devices and the GSM network. It is responsible for establishing and maintaining the communication link between the device and the network. The module also handles the encryption and decryption of data, which ensures the security of the communication. There are different types of GSM modules, each with its own functionalities. Some modules are designed to handle voice communication, while others are designed for data communication. Some modules also have built-in GPS, which allows them to provide location information.

Fig.4.Systemcomponent–GSM MODULE

ESP32 CAMERA –

The ESP32 Camera is a versatile module that combines the ESP32 microcontroller with a camera sensor, allowing for the integration of image and video capture capabilities into IoT and embedded projects. This module features the ESP32 chip, which is known for its powerful processing capabilities, low power consumption, and built-in Wi-Fi and Bluetooth connectivity. The ESP32 Camera module typically includes a camera sensor (such as the OV2640) capable of capturing still images and video footage. This sensor supports a range of resolutions and frame rates, offering flexibility for different application requirements.

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One key advantage of the ESP32 Camera module is its ability to interface with external devices and sensors through its GPIO pins, SPI, I2C, UART, and other interfaces, making it suitable for various IoT applications beyond basic image capture. The integrated Wi-Fi and Bluetooth connectivity enable wireless communication, allowing captured images or video streams to be transmitted to remote servers or mobile devices for processing or monitoring.

The ESP32 Camera module is commonly used in projects such as smart surveillance systems, remote monitoring applications, and home automation setups where visual data plays a crucial role. Developers can program the ESP32 Camera using the Arduino IDE or other development environments, leveraging the ESP-IDF (Espressif IoT Development Framework) for more advanced functionalities.

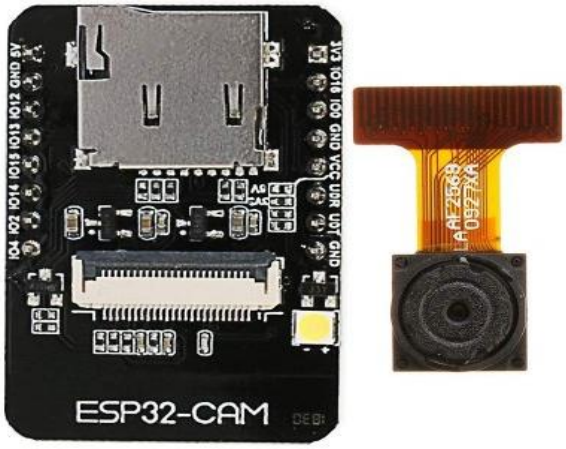

Fig.5.System component–ESP32 CAMMODULE

Overall, the ESP32 Camera module provides a convenient and efficient solution for adding vision capabilities to IoT projects, empowering developers to create innovative applications that leverage the combined power of microcontroller-based processing and image/video capture functionalities.

IV. CONCLUSION

In conclusion, the project "AI based object detection with live tracking" has successfully integrated cutting-edge technologies to achieve an innovative solution. By utilizing the ESP32-CAM for object detection, GPS NEO 6M for location tracking, and SIM800 for real-time SMS notifications, the project has demonstrated the potential of artificial intelligence and IoT in enhancing surveillance and tracking systems. The integration of AI-based object detection using ESP32-CAM has shown promising results in identifying and tracking objects in real-time. This capability can be invaluable in various applications such as security monitoring, traffic management, and industrial automation. Moreover, the incorporation of GPS NEO 6M enables precise geolocation tracking, allowing accurate positioning of detected objects. This enhances the overall functionality of the system, particularly in scenarios requiring mobile or dynamic tracking. The integration of SIM800 for sending live location SMS alerts ensures timely dissemination of critical information to designated recipients. This feature enhances the project's practicality by providing a real-time response mechanism, particularly in security and emergency situations. In summary, the project has successfully demonstrated the feasibility and effectiveness of combining AI, IoT, and GPS technologies for object detection and live tracking. Future enhancements could focus on refining the AI algorithms for improved accuracy, optimizing power consumption, and exploring additional communication channels for data transmission. Overall, this project underscores the potential of AI and IoT in advancing smart surveillance and tracking systems for various practical applications.

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REFERENCES

[1] Redmon, Joseph, et al. "YOLOv3: An Incremental Improvement." arXiv preprint arXiv:1804.02767 (2018). (Focuses on real-time object detection using deep learning, which could be relevant to your project's AI-based object detection.)

[2]Wang, Chao, et al. "DeepSORT: A deep learning based approach for object tracking." 2019 IEEE Winter Conference on Applications of Computer Vision (WACV). IEEE, 2019. (Discusses deep learning techniques for object tracking, which may relate to live tracking aspects of your project.)

[3] Liu, Wei, et al. "Deep learning for generic object detection: A survey." International journal of computer vision 128.2 (2020): 261-318. (Provides a comprehensive overview of deep learning techniques in object detection, which can inform the AI-based object detection aspect of your project.)

[4]Kolotouros, Nikos, et al. "Learning to track: Online multi-object tracking by decision making." Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2019. (Covers online multi-object tracking methodologies, relevant for live tracking using AI.)

[5] Huang, Weihua, et al. "A comprehensive survey on object detection using deep learning." arXiv preprint arXiv:1907.09408 (2019). (Provides insights into the evolution and state-of-the-art techniques in deep learning-based object detection.)