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IoT Based Night Patrolling Robot

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Abstract: *The implementation of an IoT-based smart night patrolling robot is presented in this paper, utilizing an Arduino Uno, camera module, sound sensor, ultrasonic sensor, motor driver, motors, Nodemcu, and buzzer. The proposed robot is designed to autonomously patrol a designated area and capture images and videos of the area using the camera module.*

The ultrasonic sensor is used to detect obstacles and prevent collisions, while the sound sensor is used to detect unusual sounds and alert the user. The buzzer is included to provide an audible alarm in case of any significant disturbance in the patrolling area. The robot is designed to move around and change directions using the motor driver and motors, which are operated by an Arduino Uno.

The Nodemcu provides internet connectivity, enabling remote monitoring and control. The proposed system can be used for a variety of applications, such as surveillance and security, and has the potential to improve the efficiency and effectiveness of night patrolling operations. The proposed system is developed at a low cost, making it accessible to a wider range of users.

The implementation of the proposed system has been tested, and the results indicate that the system is efficient and effective in detecting and responding to environmental stimuli. The system is controlled using a web-based interface, and the users can monitor and control the system remotely..

Keywords: smart night patrolling robot

I. INTRODUCTION

The world of technology has been advancing rapidly in recent years, and one of the most significant developments has been the rise of the Internet of Things (IoT). The IoT has enabled us to connect devices and systems through the internet, making it possible to automate and control many aspects of our lives. One area that has seen a significant impact from IoT technology is the field of security, particularly with regards to patrolling and surveillance. Smart security systems are becoming increasingly popular, and one application that is gaining traction is the use of IoT-based smart night patrolling robots. An IoT-based smart night patrolling robot is a robotic system equipped with sensors and connected to the internet. It is designed to patrol a designated area, monitor it for any signs of intruders, and alert the appropriate authorities if it detects any suspicious activity. The robot is designed to operate autonomously, eliminating the need for human intervention.

The rise in security concerns has led to an increasing demand for effective night patrolling. Traditional patrolling methods rely heavily on manual labor, which can be costly and inefficient. Advances in technology have led to the development of smart robots that can be used for various applications, including night patrolling. IoT-based smart robots are gaining popularity due to their ability to autonomously patrol designated areas and detect and respond to various environmental stimuli. In this paper, we present an IoTbased smart night patrolling robot using an Arduino Uno, camera module, sound sensor, ultrasonic sensor, motor driver and motors, Nodemcu, and buzzer. The proposed system is designed to patrol a designated area autonomously and capture images and videos of the area using the camera module. The Nodemcu provides internet connectivity, enabling remote monitoring and control. The proposed system is controlled using a web-based interface, allowing users to monitor and control the system from anywhere. The users can receive real-time updates, enabling them to detect and respond to any unusual activities in the patrolling area. The proposed system can be customized and adapted to suit various applications, such as surveillance and security in industrial sites, residential areas, and public spaces.

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1.1: Existing System :

The existing system they are all developed Ultrasonic and GSM based semi-autonomous robot. The data send via GSM Module. These existing systems don't have Surveillance system. So the system can't monitor live Environmental and live updates. So we are developed ESP32 camera module based surveillance system for live updates monitoring. And our robot Autonomous and Semi- autonomous based system control Via IoT. So we are control anywhere in the world. The Nodemcu provides internet connectivity, enabling remote monitoring and control. The proposed system is controlled using a web-based interface, allowing users to monitor and control the system from anywhere.

1.2. Literature Survey

The Movable robot for Product delivery can be developed using RF control, GPS, and the Arduino Uno microcontroller. The robot can be remotely controlled using RF signals, and GPS is used for real-time location tracking. The Arduino Uno is used for data processing and to control the robot's movements. This system has the potential to revolutionize healthcare delivery by enabling remote and automated Product delivery. IoT-based Autonomous Patrol Robot with Obstacle Avoidance and Navigation System. This paper describes an autonomous patrol robot that uses ultrasonic sensors for obstacle avoidance and a GPS module for navigation. The robot is also equipped with a camera to capture images and send them to the operator's smartphone through the internet of things (IoT) technology.

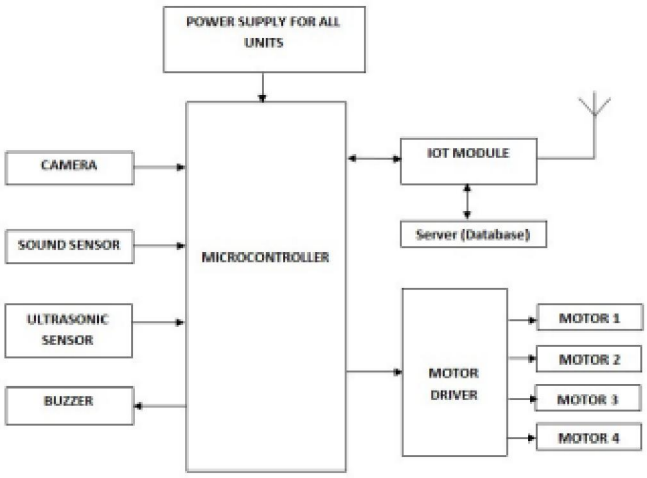
Design of IoT-Based Intelligent Patrol Robot: This paper presents an IoT-based intelligent patrol robot that uses a Raspberry Pi as the main controller. The robot is equipped with sensors, such as an ultrasonic sensor and a PIR sensor, to detect obstacles and movement, respectively. The robot is also able to communicate with the operator's smartphone through IoT technology.

Design and Implementation of a Remote Controlled IoT-Based Security Robot. This paper proposes an IoT-based security robot that can be remotely controlled using a smartphone. The robot is equipped with a camera, a temperature sensor, and a gas sensor to detect potential hazards. The robot can also send alerts to the operator's smartphone through IoT technology.

In the design and implementation of an IoT- based patrol robot for building security, several technical details need to be considered. The hardware design includes microcontrollers, sensors, motors, and communication modules. The software design includes programming languages, communication protocols, and algorithms for navigation, obstacle avoidance, and surveillance

II. OVERVIEW OF SYSTEM

2.1.Block Diagram :



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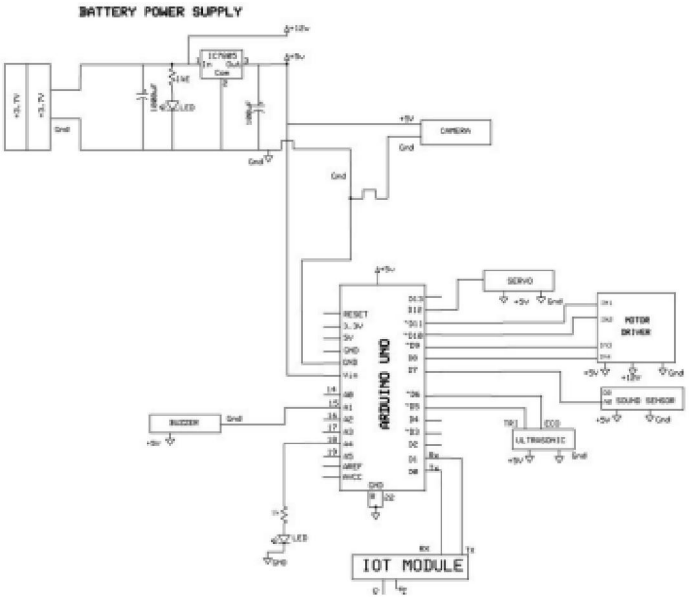
Circuit Diagram :

2.2 Circuit Diagram



2.3 Methodology

The methodology for a IoT based smart night patrolling robot involves both hardware and software components.

2.4. Hardware Explanation

IoT-based smart night patrolling robot involves the use of various components such as an Arduino Uno microcontroller board, a camera module, sound sensor, ultrasonic sensor, motor driver, motors, Nodemcu, and buzzer.

2.5.Components:

- Battery Power supply system
- Arduino Uno
- Nodemcu
- Ultrasonic sensor
- Motor Driver
- DC Bo motors
- Camera Module
- Sound Sensor
- Buzzer

2.6 Proposed System

The proposed system for IoT-based smart night patrolling robot involves the use of various components such as an Arduino Uno microcontroller board, a camera module, sound sensor, ultrasonic sensor, motor driver, motors, Nodemcu, and buzzer. The main goal of the proposed system is to design and develop a robot that can patrol a designated area autonomously, detect any unusual activity, and provide real-time feedback to the user. The system can be used in

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various applications such as surveillance and security in industrial sites, residential areas, and public spaces. Hardware components used in the proposed system include an Arduino Uno microcontroller board, which is the heart of the system. It controls the robot's movement, processes data from the sensors, and sends alerts to the user. The motor driver and motors are used to control the robot's movement, enabling it to move around and change directions. The camera module is used to capture images and videos of the patrolling area, providing visual feedback to the user. The sound and ultrasonic sensors are used to detect any unusual sound or movement in the patrolling area. The Nodemcu provides internet connectivity, enabling remote monitoring and control of the system. The buzzer is used to alert the user of any unusual activity detected by the sound and ultrasonic sensors.

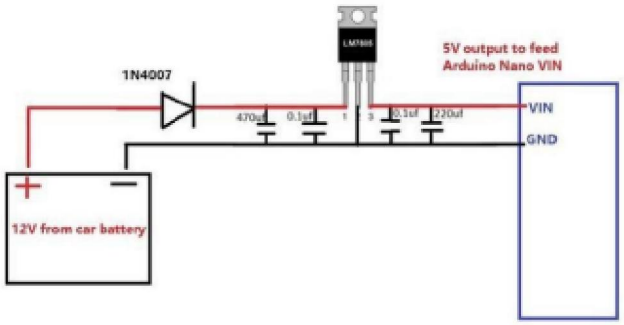
The software component of the proposed system involves the development of software that controls the robot's movement, camera operation, and sound and ultrasonic sensor operation. The software is designed to enable the robot to move around autonomously, change direction when it encounters an obstacle, and detect any unusual sound or movement in The camera module is controlled using a servo motor, enabling the user to capture images and videos of the patrolling area. The sound and ultrasonic sensors are used to detect any unusual sound or movement in the patrolling area. The Nodemcu is used to transmit data to the user, enabling them to monitor and control the system remotely. The buzzer is used to alert the user of any unusual activity detected by the sound and ultrasonic sensors. The proposed system is controlled using a web-based interface, enabling the user to monitor and control the system from anywhere. The user can receive real-time updates, enabling them to detect and respond to any unusual activities in the patrolling area. The system is designed to provide enhanced security and surveillance in the patrolling area. The system can detect any unusual sound or movement in the patrolling area, providing enhanced security and surveillance.

III. HARDWARE DESIGN

3.1 Hardware Components Description

Battery power supply system :

A 12V to 5V battery power supply is a device that converts a 12V voltage source to a 5V voltage source, typically used to power electronic devices that require a 5V power supply. This conversion is achieved using a DC-DC step-down converter or voltage regulator. This signal is then rectified and filtered to produce a stable output voltage. Voltage regulators, on the other hand, use a feedback loop to adjust the output voltage to a constant value regardless of input voltage fluctuations. When selecting a converter, it is important to consider the input voltage range, output voltage, and output current requirements of the device being powered. The input voltage range of the converter should be able to handle at least 12V to accommodate the 12V battery. The output voltage should be 5V to match the device's power requirements. The converter's output current rating should be higher than the device's maximum current draw to avoid overloading the converter.



Voltage Regulator:

The voltage regulator is the fourth and final component in the power supply system. Its function is to regulate the output voltage to a constant 5V DC voltage. The voltage regulator uses a feedback mechanism to adjust the output voltage to a constant value, even if the input voltage or load current changes.

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ULTRASONIC SENSOR:

The HC-SR04 is an ultrasonic sensor module that is commonly used for distance measurement applications in robotics and automation. It operates by emitting ultrasonic waves from a transmitter and detecting their reflection from nearby objects using a receiver. The time taken for the waves to travel to the object and back is measured, and this is used to calculate the distance to the object using the speed of sound in air. The sensor requires a 5V power supply and has four pins: Vcc (power), GND (ground), Trig (trigger), and Echo (echoed signal). To use the sensor, a trigger signal is sent to the Trig pin, and the resulting echo signal is received at the Echo pin. The distance to the object can then be calculated using the formula Distance = (Time * Speed of Sound) / 2. The HC-SR04 is a low-cost, easy-to-use, and accurate sensor that has become popular in many applications.

DC MOTOR:

DC BO gear motor is a type of DC motor that is designed with a gearbox attached to it. The gearbox is used to reduce the speed of the motor output shaft and increase the torque. This makes the motor suitable for applications that require high torque and low speed, such as robotics, industrial machinery, and automation equipment.

The DC BO gear motor stands for "Brushed Output", which means that the motor is a brushed DC motor with an output shaft that is connected to a gearbox. Brushed DC motors are commonly used in low-cost applications because they are simple, reliable, and easy to control. They have a rotor with a commutator and brushes that transfer power to the rotor windings, creating a rotating magnetic field that drives the motor shaft. The gearbox attached to the DC BO gear motor is typically made up of a set of gears with different sizes, arranged in a specific sequence to provide the desired speed reduction and torque increase.

ESP32 CAMERA MODULE:

The ESP32 camera module is a small camera unit that can be integrated with the ESP32 microcontroller for a wide range of applications. The module features a 2 megapixel OV2640 camera sensor with a resolution of 1600 x 1200 pixels, capable of capturing JPEG images and video up to 640 x 480 pixels at 60 frames per second. It also includes a built-in lens with a 120-degree field of view, making it suitable for applications such as surveillance cameras, video streaming, and facial recognition systems.

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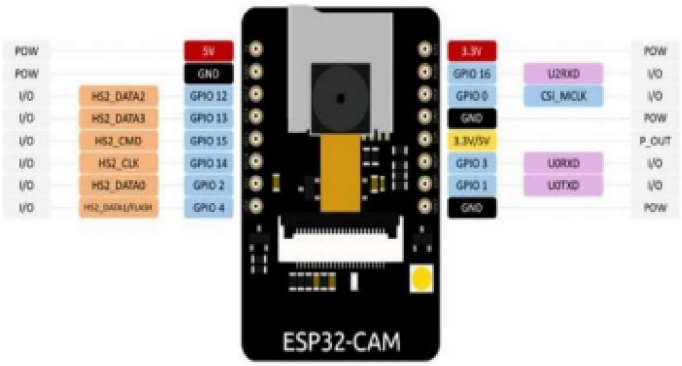

The camera module is connected to the ESP32 via a standard SPI interface, requiring a minimum of 4 GPIO pins for operation. It also includes an SD card slot for storing images and video. The module can be powered using a 3.3V power supply and consumes approximately 100mA of current during operation. It also includes a sleep mode for low power consumption when not in use.

BUZZER:

A buzzer is a device that generates sound, typically used to provide audible alerts or signals inelectronic devices. Buzzer modules are commonly used in electronic projects and can be found in a variety of shapes and sizes. A buzzer typically consists of a metal or plastic housing that contains an electromagnetic coil and a spring-mounted armature. When an electrical current is passed through the coil, it creates a magnetic field that pulls the armature towards the coil. This movement of the armature causes the device to vibrate, producing a sound. Buzzer modules are typically driven by a digital signal from a microcontroller or other digital device. The sound produced by the buzzer can be controlled by varying the frequency and duration of the digital signal. Buzzer modules can produce a wide range of sounds, from simple beeps and tones to more complex melodies. Some buzzers have built-in sound generators, allowing them to produce a variety of pre-programmed sounds or music.

IV. SOFTWARE DESCRIPION

4.1 ARDUINO IDE

Arduino IDE (Integrated Development Environment) is a software tool used for programming and development of Arduino boards. It is an open-source platform, available for free, and is compatible with multiple operating systems including Windows, Mac OS, and Linux.

The main features of the Arduino IDE include:

- Code Editor: The code editor is the main interface of the Arduino IDE where you can write, edit and upload code to the Arduino board. It includes features such as syntax highlighting, auto- completion, and code snippets to make programming easier.

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- Sketches: Arduino programs are referred to as "sketches" and can be easily created and saved within the IDE. The sketch contains two main functions: the setup() function, which is called once at the start of the program, and the loop() function, which is called repeatedly as long as the program is running.
- Library Manager: The Library Manager allows users to easily install and manage libraries for their Arduino projects. It includes a collection of pre-built libraries that can be used to add functionality to your projects. Users can also create their own libraries and add them to the IDE.
- Serial Monitor: The Serial Monitor allows users to communicate with the Arduino board and monitor the data being sent and received through the serial port. This is particularly useful for debugging and troubleshooting. •
- Board Manager: The Board Manager allows users to select the type of Arduino board they are using, configure settings, and install the necessary drivers. This is important because different Arduino boards may have different specifications and require different drivers.
- Upload: The Upload feature allows users to upload their sketches to the Arduino board and begin executing the program. Users can select the correct board and serial port before uploading the sketch.
- Tools: The Tools menu includes a range of options for configuring and customizing the IDE. This includes options for setting the board type, serial port, programmer, and other settings. Overall, the Arduino IDE is a user-friendly software tool that simplifies the programming process for beginners and experienced users alike. It is compatible with a wide range of Arduino boards and shields, making it a versatile tool for a variety of applications. With its many features and community support, the Arduino IDE is an essential tool for anyone interested in electronics and programming.

In addition to the basic features listed above, the Arduino IDE also supports advanced features such as debugging and profiling tools, version control integration, and multiple file editing. The IDE can also be extended through plugins and add-ons, allowing users to customize the tool to their specific needs. Additionally, the Arduino community provides a wealth of resources and tutorials to help users get started and troubleshoot any issues they may encounter.

4.2 Advantages :

- Enhanced Security and Surveillance: The IoT-based smart night patrolling robot offers enhanced security and surveillance capabilities. The integration of the camera module, sound sensor, and ultrasonic sensor enables the robot to detect and respond to any potential threats, ensuring the safety and security of the designated area. •
- Cost-Effective: The use of an autonomous robot for night patrolling operations is a cost- effective solution compared to manual patrolling. The robot is equipped with sensors and cameras that reduce the need for human resources, thereby reducing the cost of labor.

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- Scalability and Adaptability: The proposed system is scalable and adaptable to suit various applications. The system can be customized and expanded to suit specific needs and applications, making it a versatile solution for surveillance and security.
- Efficient and Effective: The system is efficient and effective in detecting and responding to environmental stimuli. The robot can detect sounds and obstacles in its path and respond accordingly, ensuring the safety and security of the designated area. •
- Web-based Interface: The system has a web-based interface that enables the user to monitor and control the system remotely, enhancing accessibility and convenience.

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