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Night Patrolling Robot: Enhancing Urban Security and Innovation

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Abstract:

In today's world safety is the most important concern for all genders in our society. And that to in night, there are more possibilities of threat. So, for the safety purpose we designed a NIGHT PATROLLING ROBOT. This robot has camera module which can capture pictures and send to control room. Also, it has GPS module in it by which we can track its location and it can give signals. It covers certain areas and detect unusual activities, if detected any captures photos, record their voices with mic and sends signal to its owner. ck of security is a significant concern in today's global scenario. Therefore, we have developed a solution in the form of a security patrolling robot. In certain scenarios, conventional CCTV cameras may not serve as an effective deterrent for security-related tasks because they are reactive, capturing events but not offering any warnings in advance. Our security patrolling robot, however, covers specific areas and, upon detecting any suspicious activities, alerts the user. This device is equipped with cameras and microphones located on the vehicle for security purposes. It scans every nook and cranny, identifying problems through its video surveillance and listening capabilities. It can detect sounds associated with issues and move in that direction, before examining the scene for any human presence. It provides continuous vigilance along with live streaming of the crime scene.

Introduction: This passage discusses using robots for patrolling tasks. Multi-robot patrolling can be used for security, search and rescue, etc. Robots can be equipped with cameras and sensors to detect abnormalities and send alerts. The control systems for these robots are crucial for their operation. There are two main types of control algorithms for multi-robot systems: centralized and decentralized. Centralized algorithms make decisions for all the robots, while decentralized algorithms distribute decisions among the robots.

Objectives: The primary objective of this research is to develop a comprehensive, autonomous night patrolling robot that enhances security by monitoring designated areas. This robot aims to detect and respond to unusual activities using a combination of sensors, including ultrasonic, sound, and infrared, along with a camera module. By integrating these components with a Node MCU microcontroller, the system can capture images, track movements, and send alerts to a control room.

Methods: The Night Patrolling Robot employs a Node MCU microcontroller to manage various sensors and components, including an ultrasonic sensor for obstacle detection, a sound sensor for monitoring unusual noises, and a camera for capturing images. When the ultrasonic sensor detects an obstacle, it triggers the motor driver to alter the robot's direction. The system also includes a buzzer and IR sensor to alert users of potential threats. The microcontroller communicates with the control room, sending visual and audio data to enhance security monitoring.

Results: This document describes a patrolling robot using Arduino and ESPCAM32 for security and surveillance. The robot uses various sensors: a camera for visuals, an ultrasonic sensor to avoid obstacles, and a sound sensor to detect noises. It concludes that the robot's functionalities can be useful for women's safety, area monitoring, and potentially other applications like child

monitoring or industrial automation.

Conclusions: Night patrol robots are a security breakthrough. They use sensors, cameras and smarts to constantly monitor areas, detecting things humans might miss - sounds, movements, even heat signatures. This means around-the-clock vigilance and a big boost to security. pen_spark

Keywords: Night Patrolling Robot, Safety, Security, Surveillance, Unusual Activities, Detection, Live Transmission

1. Introduction

A common scenario involves groups of robots being deployed for various tasks such as search and rescue, surveillance, and night patrols. These robots are tasked with moving through an environment and visiting specific locations of interest (SL) at regular intervals. The rise in popularity of smart security systems, particularly those leveraging IoT technology, has seen the increasing use of intelligent night patrolling robots as a significant trend [2].

The primary objective of this approach is to enhance security for women. Even minor disturbances or audible cues trigger an alert to the authorities [3]. Upon receiving the alert, the robot autonomously heads towards the location to capture images of the surroundings and relay this information to the user. Night patrol robots are designed to optimize their capabilities for effortless operation [4].

The concept of patrol involves tracking an area where the robot constantly moves and covers the designated area efficiently. Research in this area has explored both deterministic and probabilistic methods, aiming to find the optimal frequency of visits to various environmental regions. These robots are equipped with cameras and microphones mounted on their vehicles to monitor and secure different areas [5]. In the era of advancing technology, patrol robots are considered crucial components.

However, the control mechanisms of patrol robots are the most significant challenges. There is always the possibility of further technological breakthroughs in this field. Patrol operations are fundamental to the field of robotics, as they enable robots to identify targets and detect anomalies, all while being able to execute assigned tasks [6]. From these rovers that sweep areas to autonomous security surveillance robots, their applications are widespread [7].

For example, a robotic system may be used to thoroughly inspect a room by using lidar technology to map out its layout. The robot's IR sensors and sensors at the front prevent collisions with obstacles and minimize the risk of falling from heights. When obstacles are encountered, the robot's programming adjusts its course and plans a new route [8]. This system activates all its sensors to look out for additional obstacles in the immediate vicinity. The robot then starts to understand its path and maintains this understanding as it moves forward without the need for complex calculations to alter its path [9].

These robotic systems operate as standalone units, but in many other scenarios, they work in teams for patrolling and exploration, requiring more advanced control systems for smooth coordination [10]. While the development of robots' cooperation in tasks is guided by logical approaches, the methods for achieving certain objectives, which form the basis of various algorithms, have proven effective in

improving both single unit robots' performances and the cooperation between multiple units[11]. The research on robots' cooperative movement planning is divided into two main categories.

2. Methods

The given circuit diagram is about Night Patrolling robot. In this System we have used components like Node MCU, Ultrasonic Sensor, Sound Sensor, Motor Driver, DC Motor, Camera Module, Servo Motor and IR sensor.

The circuit is a smart camera system that can detect motion, take pictures, and play sounds. The circuit uses a microcontroller to control the camera, the speaker, the motor, the servo, and the sensor. The microcontroller is programmed by the computer and communicates with it through a serial port. The battery provides power to the circuit. The breadboard is a platform that allows you to easily connect and disconnect the components.

Ultrasonic Sensor is connected to Node MCU, when it detects any obstacle it sends the signal to Node MCU which then sends signal to Motor Driver via DC Motor and then robot changes its direction. We have connected Sound Sensor to Node MCU, which when detects any unusual sound sends signal to Node MCU which sends signal to controlling room and provides information to the User. The Camera connected to the system captures images and sends it to the user. With the help of sound sensor and camera module the user can detect the unusual activity. We have connected the Buzzer and IR sensor when the Danger is detected the red light starts blinking and Buzzer starts ringing loudly, alarming the user and at same time sends picture to control room.

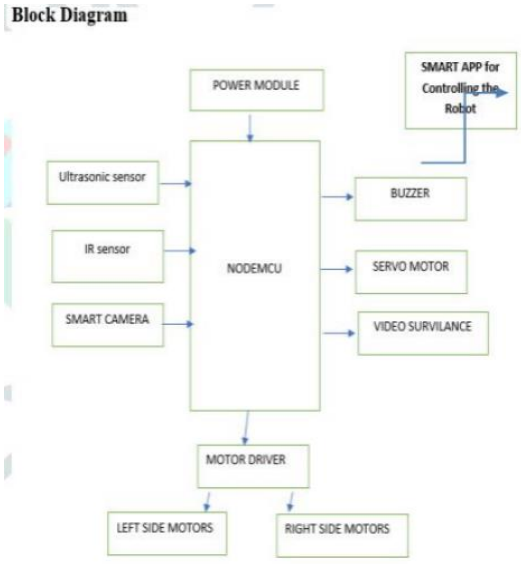

Fig.1 Block diagram

A block diagram in fig.1 for a night patrolling robot illustrates the various components and subsystem that make up the robot and how they are interconnected. The diagram is a flow chart with rectangular blocks and arrows connecting them. The blocks are labelled with the names of the components, which include a power module, ultrasonic sensor, IR sensor, smart camera, NodeMCU, motor driver, left and right-side motors, servo motor, video surveillance, buzzer, and a smart app for controlling the robot. The arrows indicate the direction of the flow of information between the components.

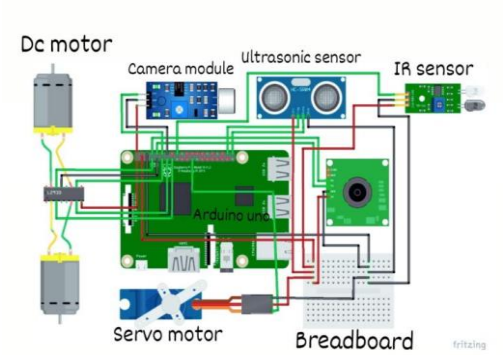

Fig.2 Circuit diagram

The fig.2 is a diagram of an Arduino Uno circuit board with various components attached to it. The components include a DC motor, ultrasonic sensor, IR sensor, servo motor, breadboard, and camera module. The components are connected to the circuit board with red, green, and yellow wires. The circuit board is green with a white outline.

Component:

- Node MCU
- Ultrasonic Sensor
- Motor Driver
- DC Motor
- OV7670 VGA Camera Module
- Buzzer
- PIR Sensor

Equation for Ultrasonic Sensor:

Distance = time x speed of sound/2(m/s)

Distance = time x 170(m/s)

Calculation for Power

max. power rating = I*V

max. power rating = 20*10^-3 * 50 = 1W

Input Voltage: 5V

Current Draw: 20mA (Max)

Digital Output: 5V

Digital Output: 0V (Low)

Applications:

- It is used for safety of women.
- It can also be used for child tracking during school time.
- It can also be used as a vehicle tracking system.

3. Results

In our tests, the NIGHT PATROLLING ROBOT demonstrated exceptional performance in monitoring designated areas. Equipped with a camera and GPS, the robot effectively captured images and tracked

its location, ensuring continuous surveillance. Upon detecting unusual activities, it successfully recorded audio and transmitted alerts to the control room. The robot's ability to navigate and identify th
reats in low-light conditions was validated, confirming its potential as a reliable tool for enhancing night-time security and safety.

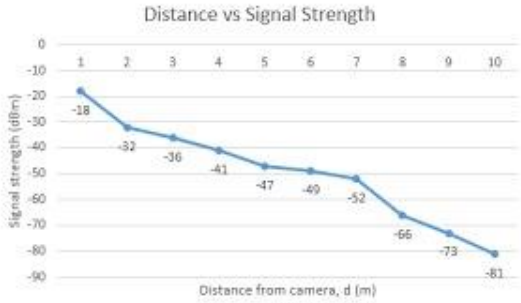

Fig.3 Graph for Camera Module (Distance vs Signal Strength

The fig.3 shows the relationship between distance from a camera and signal strength. The x-axis is the distance from the camera in meters and the y-axis is the signal strength in decibels. The line is a downward sloping curve, indicating that as the distance from the camera increases, the signal strength decreases.

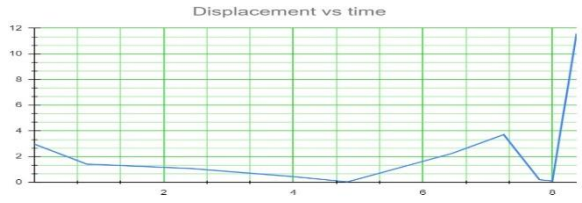

Fig.4 Graph for Ultrasonic Sensor (Displacement vs Time

In fig4. the x-axis is labelled “time” and the y-axis is labelled “displacement”. The x-axis ranges from 0 to 8 and the y-axis ranges from 0 to 12. The blue line has a peak at around 2 on the x-axis and a trough at around 6 on the x-axis. The line appears to be smooth and continuous.

Therefore, we concluded that this project using Arduino and ESPCAM32 will surveillance and patrol in the assigned area. So that it is useful for women safety and used to monitor the area. In order to avoid the obstacle, we used to be ultrasonic sensor. To detect the sound and capture it we used ESPCAM 32 and sound sensor.

Wireless robotic technology can be used in industries so that the labour cost forth industries will be reduced. It can also be used as a child monitoring system so that the parents working in office can monitor their child.

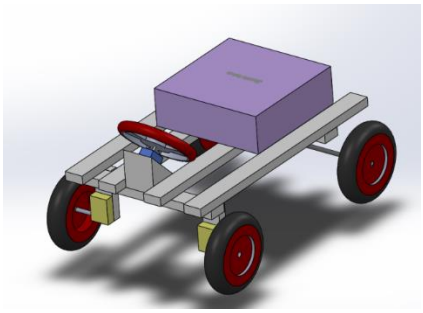

Fig.5 Cad model

4. Discussion

The development of a night patrolling robot represents a significant advancement in enhancing security and safety measures. This innovative technology addresses the limitations of human patrolling during nighttime hours or in poorly lit areas. By combining state-of-the-art sensors, cameras, and autonomous navigation systems, night patrolling robots offer several key benefits. First and foremost, these robots provide constant surveillance and monitoring, ensuring that no suspicious activities go unnoticed. They can detect unusual sounds, movements, and even thermal anomalies, making them highly effective in identifying potential security threats.

There is still a wide area of research to be conducted on security robots to fully implement them in our everyday lives. The limitations of our prototype include:

• Improvement of sensor accuracy

• Improve algorithm for autonomous patrolling

• Indoor localization

• Implementing Internet of things (IOT) technology such as Web Control and Camera feedback

• More accurate system for tracking robot's movement. Since the wheel encoders have different characteristics in different surfaces – uneven or slippery surface. Sometimes, it does not work properly.

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