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# Nocturnal Patrolling Robot

Akshatha M<sup>1</sup>, Sunitha G.P<sup>2</sup>

Student<sup>1</sup>, Associate Professor<sup>2</sup>, Department of Master of Computer Applications  
 JNN College of Engineering, Shivamogga

[akshathamgowda123@gmail.com](mailto:akshathamgowda123@gmail.com)<sup>1</sup>, [sunithagpise@gmail.com](mailto:sunithagpise@gmail.com)<sup>2</sup>

## Abstract

Counteracting a common problem in society that is theft, the nocturnal patrolling robot has been brought to life by exploiting the advanced IoT features of an ESP32 microcontroller. To visit regions where burglary cases are often rampant, this independent machine relies on sound sensors for obstacle detection and movement. What it can do includes responding to sounds, going towards possible points of intrusion and imaging invaders using ESP32 Camera Module that has night vision. This allows users to receive such photos through email via a GSM module for full time notifications. Moreover, a buzzer acts as a deterrent against intruders. All from alert text messages to picture taking to buzzers have been invented earlier, but the GSM call was specifically designed to keep people informed at night. which called people at night as no one bothers to check their email all night long. To overcome this problem in previous work, GSM calls were introduced in this work. The affordable ESP32 and Arduino Uno combination provide an elegant solution for securing valuable items while enhancing safety for women during the dark hours.

**Keywords:** patrolling, ESP32, ultrasonic sensor, GSM module, buzzer, Arduino Uno.

## 1 Introduction

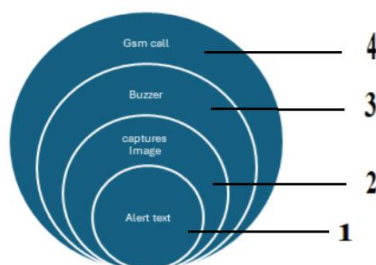
The prevention of regular thefts and breaches, the night patrolling robot that is controlled by an ESP32 and IoT is a creative solution. For motion control and object detection that perhaps a threat, this self-organizing robot uses ultrasonic sensors. It also acoustically documents the environment to identify irregular movements when there isn't light. With the features of GSM module and siren and movement sensor, it scares off intruders and provides real time alert. The ESP32 camera being an environment-friendly device together with the Arduino Uno forms an excellent night security system that guards a person's property and ensures safety to most especially women. This invention explains how IoT technology in a practical approach may address the modern security challenges.

As it is shown in the Fig1. It is given that the diagram shows the generations of patrolling robots In the aforementioned Fig1, the alert text was offered in the first generation, the picture was captured and sent to the user via email in the second generation, a buzzer was proposed in the third generation, and a GSM call was proposed in the fourth generation, which is invented in this work that helps in alerting users more specifically along with sending images and alert text this will helps in making call as no one will check their email at night time.

## 2 Literature Survey

Related studies that have been conducted various methodologies and techniques includes. Zindha Madhar et al (2023) [15] The IoT-Powered Night Patrol Robot analyzes intruders, takes photos, informs owners through Wi-Fi, stores photos and essentially locks itself. It does all of these things with the assistance of a night vision camera and the most popular single-board computer Raspberry Pi. Bhavya Chadha (2020) [5] Develop a

Fig1: Stages of implementation



Wireless Surveillance robot with the following capacities, air leakage and intrusion detection sensors, Bluetooth, automobile ground vehicle (AGV) navigation, GSM, safety every angle monitoring. Vivek Upadhyay et.al (2023) [14] In a bid to enhance the security of the RoboSecIoT Patrolling Robot, gesture and face detection, Bluetooth & Wi-Fi, Arduino IoT, cameras to capture pictures & videos, remote access & minimizing human touch will be incorporated. P. Anbumani et.al (2023) [12] The procedure for using the IoT Based Smart Night Patrolling Robot for enhancing the security during the night includes using a camera, NodeMCU, and sensors. Joel Chacko, et.al. (2021) [8] Engaging the Soundbots, night vision cameras and instant IoT danger analysis for transferring security duty with night patrolling robot to minimize the actual human guards and security work. A Raganna et.al (2021) [3] The IoT Night Patrolling Robot for Women's Safety has plans for Video Recording & Instant help Button along with GPS, Arduino, GSM to convey position and to call for help. Abhijit Paradkar et.al (2015) [1] An All-in-One intelligent safety system for women was created to enhance security and provide the function of sharing emergency maps with kin and police in real-time with the help of technology. Monisha K et.al (2021) [10] developed a Patrolling Robot with cameras and sound detectors that is linked

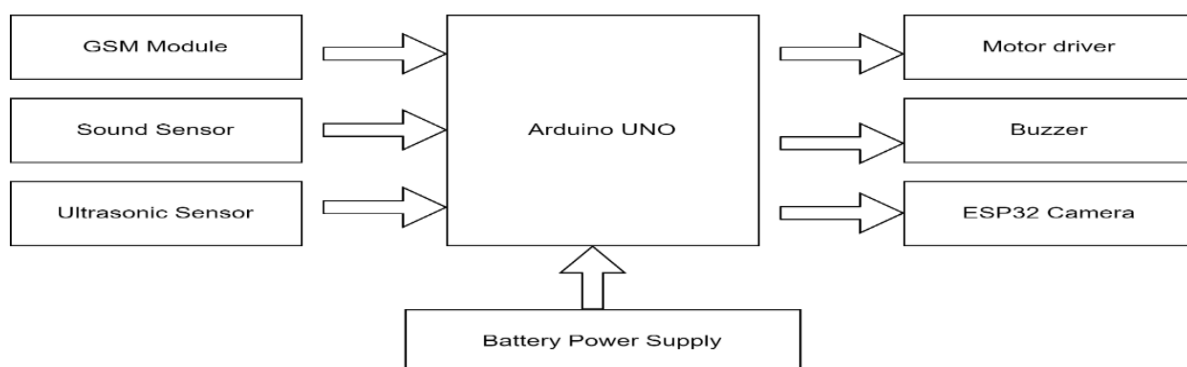
to a mobile application in the use of ReactNative created to address crimes in real-time hence enhancing home security. Ms.T. Gophika et.al (2023) [11] The Automatic Night Patrol System, containing an IoT robot and a Raspberry Pi to offer extended yet affordable solutions to troublesome areas, features' sensors and computation for autonomy in monitoring. Dushyanthkumarsinghet.al (2017) [7] Lowered personnel and equipment expenses by employing hostile violation identification and response with smart border control supported by an automated intruder fighting system machine vision and smart fences. After considering every linked work, proposed Nocturnal Patrolling Robot. This is because when comparing all associated work, it is obvious that Arduino Uno, buzzer, and GSM module are most suitable, simple to use and cheap. In this proposed work the above-mentioned components will be utilized to make a realistic robot. The main features include sending a warning text and photograph to email, and warning by buzz and call.

### 3 Proposed System

The proposed model involves both hardware and software components.

#### 3.1 Block Diagram

The functional diagram presented in fig3.1 gives a description of the workflow of the designed patrolling robot.



**Fig 3.1: Representation of Module.**

A board computer that can process data in real time, an ultrasound collision avoidance radar sensor, which detects obstacles in front of it,




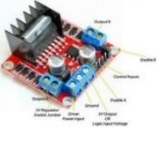




batteries as energy sources, a microphone or speaker unit that makes sounds or plays back stored messages, alarm bells set off by acoustic


signals, a GPS module that sends out pieces provide for constant surveillance. warningcalls if there is too much traffic. These

### 3.2 Hardware Specifications

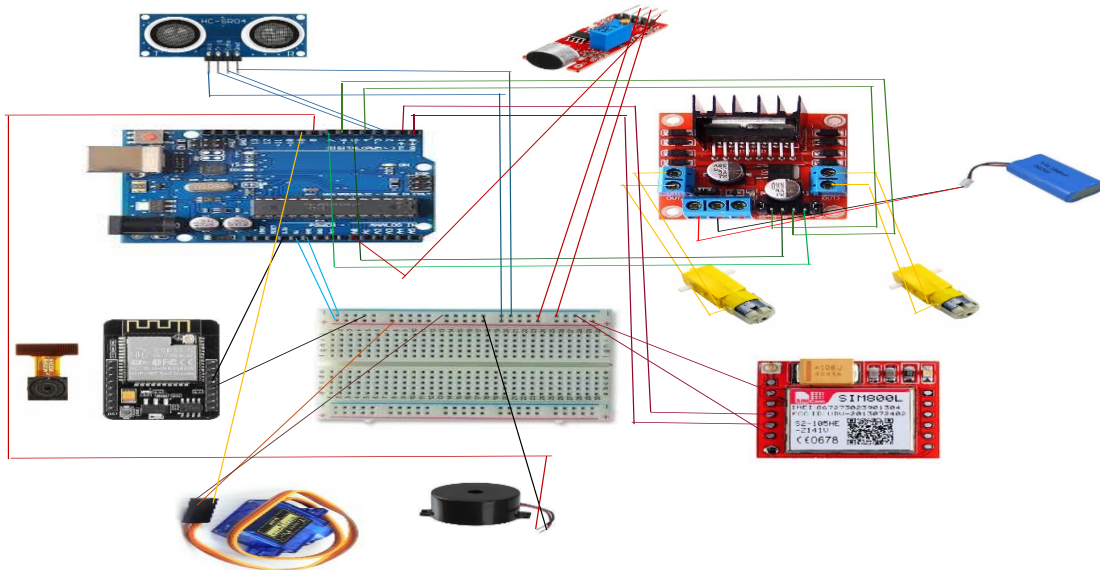
The surveillance System is developed using componentdescription and their contribution to the following components. The designing the robot is represented in table 3.2.

**Table 3.2 Hardware Description**

Sl. No	Component	Function	Cost	Images
1	Arduino Uno	Arduino uno manages the electronic systems, which are involved in monitoring the environment, detecting obstacles and navigation.	Rs.750	
2	Sound sensor	The sound sensor gets to hear some awkward noises and to enhance security, generates alarms or shifts in the pathway.	Rs.60	
3	Ultra Sonic Sensor	First, the ultrasonic sensor checks the distance to control and avoid an impact with any objects or means.	Rs.148	
4	Motor driver	To ensure accurate movement of the robot, the motor driver adjustments the direction and speed of the motor based on the inputs of the microcontroller.	Rs.214	
5	Buzzer	In case of abnormalities, the buzzer provides an alert immediately so that the specific action is not delayed.	Rs.15	
6	GSM module	Emergency signals and voice interfacing with the device are made possible via conversing with others or via assistancefrom the GSM module.	Rs.199	
7	DC Motors	Mobility which is employed when on patrol is credited to DC motors and important when it comes to handling different terrains and obstacles.	Rs.149	
8	ESP32 Camera	For surveillance, real time video feed is sourced by the OV7670 camera module while for identifying obstacles in low light conditions they are useful.	Rs.730	

9	Battery Power Supply	This battery power source supplies energy to all the parts that incorporate innovation for time-bound, exclusive navigation and observation without needing a power source.	Rs.350	
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### 3.3 Circuit Diagram



**Fig 3.3 Workflow of modules**

The communication of the components in the night patrolling robot is illustrated in Fig.3.3. Powered by a transmitter and receiver which emit 40 kHz, the ultrasonic sensor determines the time it takes to receive the echoed waves and then divides this time by the speed of sound in air, which is 343 m/s. During the movement of the robot, the ultrasonic sensor sends alerts back to the microcontroller Arduino Uno about some obstacle in advance. Once an item is identified as being within the threshold distance, the motor driver is then prompted to change the layout of the robot. Microphone is often used as the sound sensor to convert the sound waves into the electrical signal that provides the frequency and amplitude of the sound. This signal is then converted into digital form, and if needed or required, amplified so that the microcontroller can take the signal further. The microprocessor instructs the motor driver to move the robot in the direction of the sound aided by the

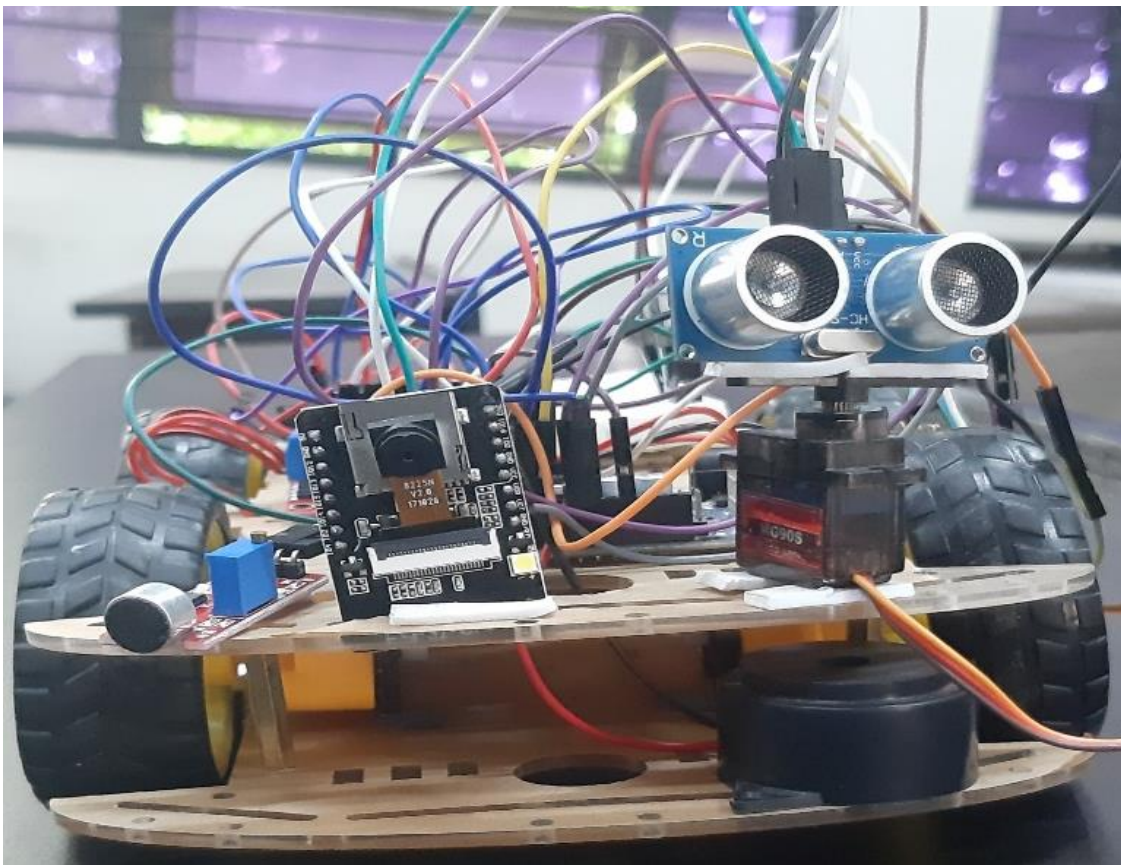
distances of the microphones to determine the presence of sound, its intensity additionally its direction. ESP32 camera is activated by sound and captures a picture; the picture is stored and a Wi-Fi connection is created to send the image through email. Finally, once ESP32 transmits the picture, the GSM module interfaced to the microcontroller powers on and provides a call to the user on activities. This makes that the call notifies the user even if the email is not opened or read by the recipient. The loud ringing of the buzzer ceases after the call; it was more of a signal against intruders. All of them are controlled by Arduino Uno ensuring that the robot can identify and document findings, monitor for the intruder, inform the user, and sound an alarm to guarantee complete security.

### 3.4 Proposed Model

The surveillance system to incorporate a central controller such as Arduino Uno to control other devices like esp32, ultrasonic

among the previously discussed components. This enables the robot to be controlled and it has obstacle detection ranging from 10cm for avoidance of any contacts. Sound sensors are employed to detect noises when the threshold is higher than the previously mentioned ones. It establishes into which sector, be it left, right, front or rear, the signal is originating from and then adjusts in that direction in accordance to the limit that was set in the code above. After that, the ESP32 camera module has a Bluetooth and Wi-Fi connection whose

over Wi-Fi. After sending the email, the GSM Module will then initiate a call through the speaker to the user, which should have provided prior notification on the amount of time the delay is existing inside the code. As supported earlier, GSM calls were invented in this model to enable the users to get alerted more accurately as they do not know that the email can be of notifying nature. A little later, the buzzer blows a siren, thus it makes it possible to effectively chase out potential



function is to help in taking pictures and also enable a user to receive the taken photographs intruders and guard property.

**Fig 3.4: Patrolling Robot**

#### 4 Results

The robot enhances the user security at night by effectively protecting the valuable property through the robot's patrol. The robot ensures that any attempted by the intruders is detected on time and dealt with by actively monitoring the environment and searching for any

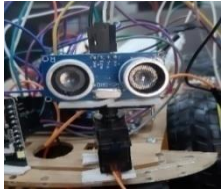
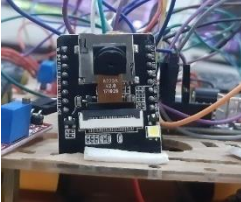
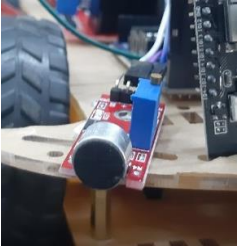

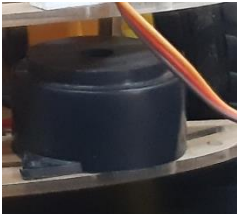
intrusions. To raise awareness whenever there is a danger, it photographs them and sends an email to all the users. Further safety is provided by voice calling warnings that are initiated immediately by the GSM module. The buzzer inclusion makes sense because by

sounding the buzzer, an alert is created to anyone around and or probably scares away potential attackers. Such an all-round solution relieves the consumers the burden of worrying and stressing themselves about their items as

they are assured that it is always being monitored and protected.

Verification of results is done using various components and are recorded in below table.

**Table 4: Results through various components.**

Sl. No	Component	Figure	Description	Key Feature
1	Ultrasonic Sensor		Ultrasonic sensor can identify obstructions up to 10 cm away, assuring safety and preventing collisions while on patrol	Detects obstacle and make its own path and avoids collision.
2	ESP32 Camera		ESP32 take pictures of obstructions and sounds and transmit them to pre-designated emails for real-time security monitoring and proof	Capturing images and helps to send the images to the user.
3	Sound Sensor		robot rotates according to high frequency noises and measures its intensity by means of microphone through Arduino and make its own path towards the noise.	Detects the sound and make its path towards the noise.
4	GSM Module		The GSM module sends and receives signals to a mobile device on the status of the robot and if it has discovered any issues.	Sending alert text with image to the email and make a call to the user.
5	Buzzer		The buzzer improves quick response and deterrent skills by acting as an audible alarm to notify security staff of crises or detected incursions.	Ringling buzzer after the user get the call by the GSM module.

## 5 Conclusion

Using ESP32 Internet of Things features, the nocturnal patrolling robot assists in

discouraging theft and detected criminals with a high success rate. When someone invades your space, it captures pictures and forwards

them to you, additionally to featuring night vision, sound waves and finally voice detection. A buzzer and GSM device offers you alerts when something is out of stock in the stock list. Moreover, with the introduction of GSM Call, the problem of the above work was also solved with the related work of informing consumers through a phone call instead of alert

### 5.1 Future Enhancement

- Increased AI levels
- longer battery duration
- self-charging capability

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