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IoT-Based Autonomous Surveillance Robot

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Abstract - The proposed system is a cost effective four wheeled surveillance robot using an Arduino UNO microcontroller and an Android smartphone. The surveillance robot consists of a camera, PIR sensor and an Ultrasonic sensor. The robot can be controlled using manual mode on Android app or in automatic mode that uses obstacle avoiding algorithms to control its own path. The object detection is done using Ultrasonic sensor. The robot uses PIR sensor for intruder detection and alert the specific authorities who can check the anomalies on live feed using camera mounted on the robot. The robot can be controlled remotely using Internet with the help of Wi-Fi module.

***Key Words*:** IoT, Surveillance, Robot, Arduino, Obstacle Avoidance, Ultrasonic sensor, PIR sensor.

1.INTRODUCTION

IoT or Internet of Things describes the connection of physical objects that are embedded with a software, multiple sensors, and various other technologies to achieve the goal of connecting and transferring data with other devices over the web. IoT is one of the rapidly evolving technologies of this century. Now that we will connect everyday objects like cars, kitchen appliances, baby monitors, thermostats, etc. to the web via embedded devices, seamless communication is feasible between processes, people, and things.

A mobile robot could also be a machine controlled by software that uses sensors and other technology to identify its surroundings and move around its environment. Security robots move around in a specified area automatically, without any direct operator supervision. Images from its built-in cameras are transmitted to the safety station. If a stationary security sensor is triggered, the robot changes its route and moves to things of the possible alert accesses, and things.

The emergence of security robots may be a new milestone within the evolution of security systems—an emerging stage of technological development that brings the whole industry up to new standards of best practices expected within the profession of securing people and property. Autonomous mobile robots designed for outdoor use can reduce or completely eliminate the necessity for human workers to ensure the security of our houses or even huge plots like companies or offices. Security robots are ready to provide the highest level of security at a very modest cost.

It is our aim to design and build a fully-featured surveillance robot that has obstacle avoidance abilities to secure the premises with minimum human efforts and money.

The key main points of the proposed system are as follows:

A. Surveillance Robot

Surveillance robot is a type of robot with the aim to roam around an environment and provide audio and video information from the given environment, this information is then sent to the user. Users can control the robot in multiple modes with the help of a mobile or a laptop through the concept of Internet of Things (IoT).

B. Human Intrusion Detection

A human intrusion detection system is meant to detect any unauthorized entry into a building or a protected space and deny such unauthorized access to safeguard personnel and property from injury or hurt.

C. Obstacle Avoidance

Obstacle avoidance is one among the prime problems associated with autonomous navigation of mobile robots. It's not a viable choice to model entire environment in which the robot roams. In order to maneuver in a dynamic environment, the robot has to be equipped with an obstacle avoidance algorithm to deal with obstacles which were not known beforehand. It can be used for many different types of machines such as industrial robots, modern cars, or Drones.

2. Literature Survey

Robots built with surveillance properties are becoming quite popular. A lot of research has been done on the algorithms used to gain obstacle avoiding abilities. A brief overview of the existing algorithms is:

Bug Algorithm: It is one of the simplest obstacle avoidance algorithms. When an obstacle is encountered, the robot fully circles the object to find the shortest distance to the goal.

Potential Field Algorithm: In this algorithm, the robot is assumed to be driven by virtual forces that attract it towards the goal and reject it away from the obstacles.

Vector Field Histogram: It creates a polar histogram using several recent sensor readings. The histogram is used to identify all the passages or valid paths for the robot to move so as to reach the goal.

Bubble Band Technique: This method defines a bubble containing free space around the robot. A band of such bubbles are used to plan a path between starting point and the goal.

The most common existing system includes an Arduino microcontroller and an Ultrasonic sensor for obstacle avoidance feature. This system is presented in paper [3] "IOT Based Surveillance Robot". The intruder detection or alerting the user is a very important feature for any Surveillance robot, so we have included these processes in the proposed system.

In the paper [1] "Design and Analysis of IOT-Based Intelligent Robot for Real-Time Monitoring and Control" published in 2020 at International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC). This paper presents the way to design and implement a mobile robot for obstacle detection and avoidance in a real-time basis. The system is rather costly due to addition of Raspberry Pi 3. The Raspberry Pi is a complex micro-controller which makes it difficult to work on and thus is less scalable.

In the paper [2] presented "Intelligent Surveillance Robot", published in December 2018 at the First International Conference of Electrical, Communication, Computer, Power and Control Engineering ICECCPCE. The paper focuses on design and implementation of mobile robot that can perform: obstacle avoidance, face recognition and detection of combustible gases. They implemented face recognition on artificial neural network on a field programmable analogue array which increases the complexity of the system. The complex nature of the system makes it very hard for further enhancement and is also very cost inefficient.

3. System Design

The system comprises two major sections- the user application and the robot section. The remote-controlled car is controlled by the users using a laptop or mobile from a remote location. The robot can be operated in two modes: manual and automatic. The user application has a GUI to control the robot in manual mode and has camera view, where the video is transmitted through the Wi-Fi module which connects the Arduino with the application.

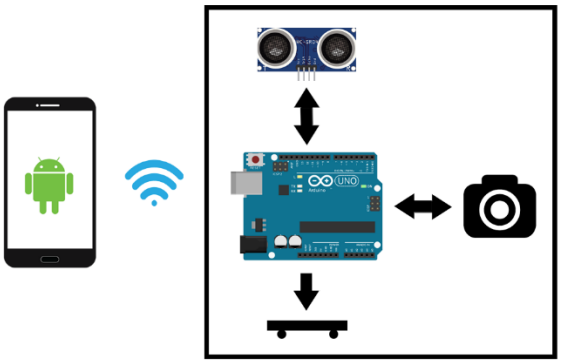

Fig -1: Overview of System

We are building a wireless surveillance monitoring framework utilizing Arduino Uno. Using the Arduino microcontroller, DC motors and motor driver we construct a mechanical vehicle. The robot is embedded with Passive Infrared sensor and Ultrasonic sensors to serve the purpose of anomaly detection and obstacle avoidance respectively. PIR sensor detects any motion using infrared radiation and sends an alert if any intrusion is found. Ultrasonic sensors are used to detect any obstacles in the path and send signals to change the direction of robot in automatic mode.

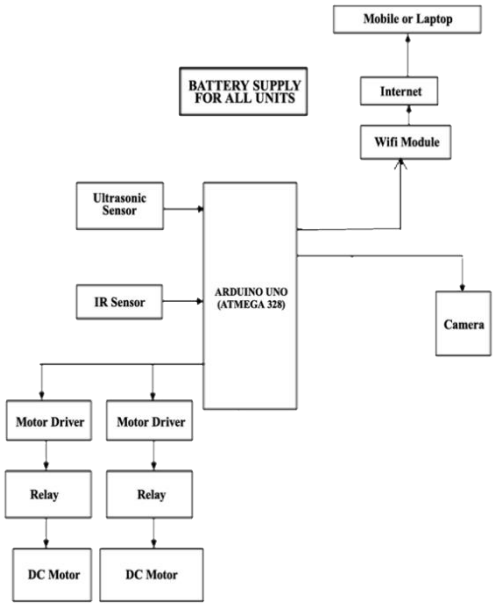

Fig -2: Block Architecture of System

4. Hardware Used

The surveillance robot requires a number of fundamental hardware parts for appropriate working. The fundamental parts utilized in our project and their particulars and functions are as per the following:

A. Arduino Microcontroller

Arduino is an exceptional apparatus for checking out and control a greater amount of the actual world than your PC. It's an open-source actual figuring stage in view of a straightforward microcontroller board, and an advancement environment for composing programming for the board. The Arduino programming language is an execution of Wiring, an indistinguishable actual registering stage, which is predicated on the Processing media programming environment.

B. Wi-Fi Module

ESP8266 might be a finished and self-coordinated Wi-Fi network arrangements that might convey programming applications, or through another application processor uninstall all Wi-Fi organizing capacities.

ESP8266 when the gadget is mounted and it is the main use of the application processor, the non-unstable capacity is frequently begun straightforwardly from an outer Move. Inherent reserve memory will assist with further developing framework execution and diminish memory prerequisites. Another circumstance is when remote Internet access expect the assignment of Wi-Fi connector, you'll add it to any microcontroller-based plan, the association is direct, just by SPI/SDIO point of interaction or processor AHB span interface. Handling and capacity limit on ESP8266 strong piece, it is frequently coordinated through GPIO ports sensors and different applications explicit hardware to acknowledge absolute bottom ahead of schedule inside the turn of events and activity of at least involve framework assets.

C. Ultrasonic Sensor

An ultrasonic sensor is an electronic gadget that actions the distance of an objective item by producing ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel quicker than the speed of discernible sound (for example the sound that people can hear). Ultrasonic ranging module HC - SR04 gives 2cm - 400cm exchange estimation work, the running exactness can reach to 3mm. The modules include various kinds of ultrasonic transmitters, recipient and negative input circuit.

D. Passive Infrared Sensor

The PIR sensor itself has two openings in it, each space is made of an exceptional material that is susceptible to IR. The focal point utilized here isn't doing a lot of then we see that the two spaces can 'see' out beyond a lengthy way. At the point when the sensor is inactive, the two spaces identify a similar measure of IR radiation, the amount emanated from the incorporating or dividers or outside. At the point when a warm body sort of an individual's or creature cruises by, it first catches one 1/2 of the PIR sensor, which causes a positive differential change between the two parts. At the point when the glow signal body leaves the world, the opposite instrument happens where the sensor produces a negative change. These change pulses are what's distinguished.

E. Motor Driver Module

The L293D is a 16-pin Motor Driver IC which can handle a bunch of two DC engines all the while toward any path. The L293D is intended to give bidirectional drive flows of up to 600 mA (per channel) at voltages from 4.5 V to 36 V (at pin 8!). You can utilize it to control little dc engines. In some cases, it tends to be incredibly hot.

5. Obstacle Avoidance System

Obstacle avoidance has an utmost important role when it comes to security systems operating in automatic mode. To ensure the robot navigates in a dynamic environment without any hurdles we need it to be equipped with an obstacle avoidance algorithm. The most common obstacle avoidance algorithms used in various robots are:

A. Bug Algorithm

B. Bubble Band Technique

C. Vector Field Histogram Algorithm

D. Potential Field Algorithm.

6. Proposed Obstacle Avoidance Algorithm

The ability to recognize and keep away from obstacles in real time is critical for any execution of the control framework for autonomous vehicles. Tragically, the vast majority of those solutions demand a significant computational capacity, which makes them troublesome, if not impossible, to execute on minimal expense microcontrollers.

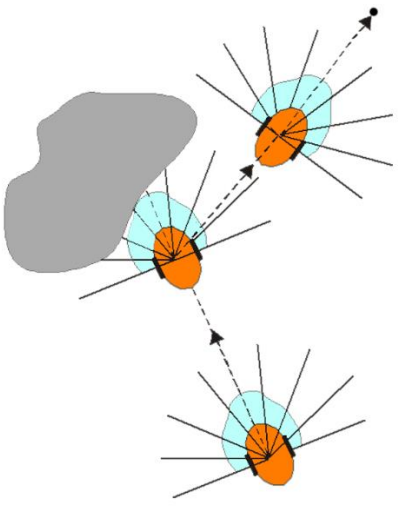

Fig -3: Demonstration of Proposed Algorithm

7. Applications

Following are the main applications of the surveillance robot:

1. By integrating camera attributes with the robot, we can effectively screen indoor just as open-air areas during daytime and around evening time.
2. Distant regions can likewise be explored.
3. It tends to be utilized from a distance and doesn't need labor.

8. CONCLUSIONS

In this paper, we effectively discussed the system for making a robot for surveillance. We can handle the robot with the assistance of an android mobile/laptop in manual mode. Programmed monitoring is also possible by utilizing an obstacle avoiding algorithm. Our proposed robot is little in size accordingly moving into region where human access is incomprehensible.

REFERENCES

1. Mona Kumari, Ajitesh Kumar and Ritu Singhal, "Design and Analysis of IoT-Based Intelligent Robot for Real-Time Monitoring and Control," 2020 International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC), Mathura, India.
2. Dr. Thair Ali Salh and Mustafa Zuhaer Nayef, "Intelligent Surveillance Robot," The First International Conference of Electrical, Communication, Computer, Power and Control Engineering, ICECCPCE (2013).
3. G. Anandravisekar, A. Anto Clinton, T. Mukesh Raj and L. Naveen, Department Of Electronics and Communication Engineering Saranathan College Of Engineering Trichy, Tamilnadu, India
4. Mohammad Shoeb Shah, Borolo. P.B. "Surveillance and Rescue Robot Using Android Smart Phone And Internet". International Conference on Communication And Signal Processing, India. (2016)
5. Punarjay Chakravarty, Alan M. Zhang, Ray Jarvis and Lindsay Kleeman, "Anomaly Detection and Tracking for a Patrolling Robot," Intelligent Robotics Research Centre, Monash University, Clayton, Victoria 3800, Australia.
6. Anand Nayyar, Vikram Puri, Nhu Gia Nguyen and Dac Nhuong Le, "Smart Surveillance Robot for Real-Time Monitoring and Control System in Environment and Industrial Applications," Information Systems Design and Intelligent Applications, Advances in Intelligent Systems and Computing 672, 2018.
7. K. S. R. Sastry, A. N. V Samba siva Rao2, K.Baji Babu, N.Rama Krishna, "Multi-Purpose Robot using Raspberry Pi & Controlled by Smartphone," International Journal of Engineering Research and Application, March 2017.