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Home Surveillance Using Robotic Eye

Dr. Ambidi Naveena[1], Kandle Meghana[2], Sravya Jale[3]
[1, 2, 3]*Dept. of Electronics and Telematics, G. Narayanamma Institute of Technology and Science,* Hyderabad (for women)

Abstract: Security is the primary concern for everyone. This project is aimed at providing security to homes, banks, museum using robotic eye surveillance system. This project is used to detect the motion using sound technology and provides live streaming when required.
Here, a technique of robotic eye surveillance is presented that uses active/passive sound motions to capture and record intruders. This project comprises an eye that mimics a robot eye and a servo motor controlled by Arduino NANO that allow the robotic eye to move. There is of course a sound level measurement and its visualization through a mounted camera inside the eye which is ESP32-CAM, which now acts as an input. And it provides surveillance in 3 directions x, y and z. So, how can the robot know the time it should react? And for what signals it should react? It is decided by time of sounds. The difference is done with the frequencies that are involved and sudden increase of sound intensity. Since 2 microphones are used for direction of sound detection and the continuous sound measurement shows the stepping up of the sound and eventually captures.
Keywords: Arduino IDE, ESP-32 CAM, Micro phones, Security, Web Server, Wi-Fi access point.

I. INTRODUCTION

In the present world, security concerns have increased enormously and dramatically and now there is a need to monitor and secure residential properties remotely.
Many different types of security robots have been introduced and developed in various fields. Specifically introducing home automation systems not only promote life quality, and convenience but also provide security [10]. This project mainly focuses on home security problems.
The proposed security system is Home Surveillance using Robotic Eye based on a sensor network that is configured by Arduino Nano, servo motors, a camera module, and sound sensors (microphones) [12]. Using a video camera intrusion detection is done by capturing a huge amount of data that is monitored and screened. The captured data is streamed live on the remote devices of the user constant monitoring and intrusion detection [9].
Present surveillance systems need constant human vigilance but humans have fewer abilities to perform in real-time. From the point of view of forensic investigation, there is a need to analyze a large amount of video data obtained from surveillance videotapes. This task is very time-consuming and error-prone for a human investigator.
However, in the proposed system, since the user would be having a constant screening in his device, the detection of the intrusion is known [13]. Thus, this project can be useful in overcoming the drawback of present-day security systems by saving time in analyzing a large amount of stored data. The proposed system can perceive disturbances and respond to them in real time [8].

II. LITERATURE SURVEY

A. Overview of Home Surveillance using Robotic Eye

Arduino Nano microcontroller is used for a robotic eye because of its numerous advantages it also has an open-source platform and also can be used for live streaming capture. The system uses ESP32-CAM. The ESP32-CAM uses a Wi-Fi access point with a secure connection and is a low-power device used to exchange data between devices without any physical connections such as cables or wires [14]. The main goal of the robotic eye is to pick up events by sensing nearby sound signals and turning accordingly. When a user or intruder gives any specific sound, the robotic eye will turn in the direction of the sound sensed first, the robotic eye starts capturing video of the intruder which will be accessed by the user, connected to an Arduino unit using ESP32-CAM module [15].

III. HARDWARE PLATFORM

The robotic eye is developed using an ATMEGA328P (Old Bootloader) Arduino NANO and receives data from the ESP32-CAM module via sound sensors.

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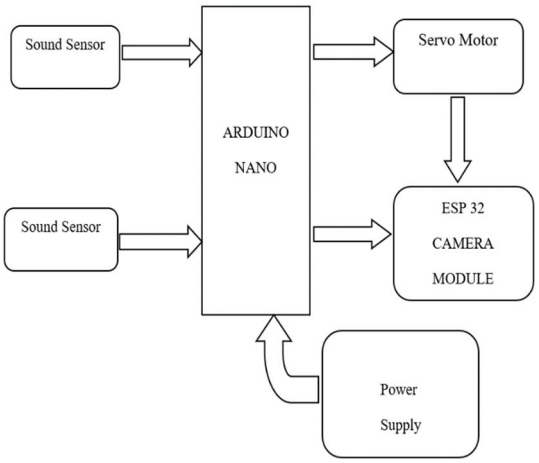


Fig.1. Block Diagram of Home Surveillance using Robotic Eye

Home surveillance using a robotic eye system consists of a microcontroller to which sound sensors are connected. The microcontroller used in this system is Arduino Nano AtmegaP32 (Old Bootloader). Arduino Nano is a microcontroller that is similar to Arduino UNO, unlike UNO Nano board is small and also cost-effective.

It also consists of 2 analog microphones placed on either side of the system. The output of these sound sensors is given as input to the Arduino Nano board. A servo motor is also connected to the microcontroller and the output of Arduino nano is given as input to the servo motor. A camera module i.e., ESP32 cam is mounted upon the servo motor which enables the camera to rotate in the required direction i.e., the direction in which the sound is detected. If no sound is sensed by the microphones, then no input is given to the servo motor and hence the camera resides in the idle state facing the center. The complete system is provided with an external power supply of 6V.

A. Arduino Nano

Arduino Nano is a microcontroller that has functionalities similar to Arduino UNO. But Arduino Nano is smaller in size when compared with Arduino UNO [7].

Arduino nano is small in size, portable, flexible, and breadboard-friendly microcontroller, based on ATmega328p, developed by Arduino. cc. It consists of 14 Digital Pins, 8 analog Pins, 2 Reset Pins, and 6 Power Pins, configured in a DIP30 package. Arduino IDE is the software that is used for programming, it is easy to access and runs both offline and online [11].

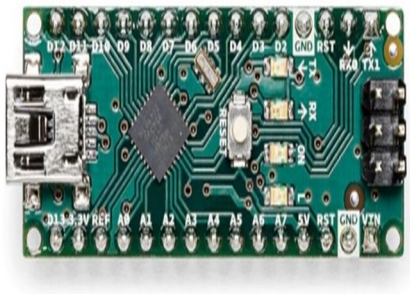


Fig.2. Arduino Nano Board

B. ESP32-CAM

The ESP32-CAM Module with OV2640 Camera Module 2MP and several GPIOs are used to connect peripherals for Face Reorganization and it consists of a small-size camera module which operates independently as a minimum system, it requires a 6mA current [2]. It also contains a microSD card slot that can be used for storing images and/or videos taken with the camera and even allow live streaming by connecting with web server [9]. It has wide range of IoT applications.

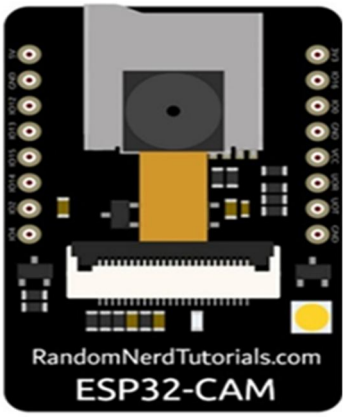


Fig.3. ESP32-CAM

C. Flow Diagram

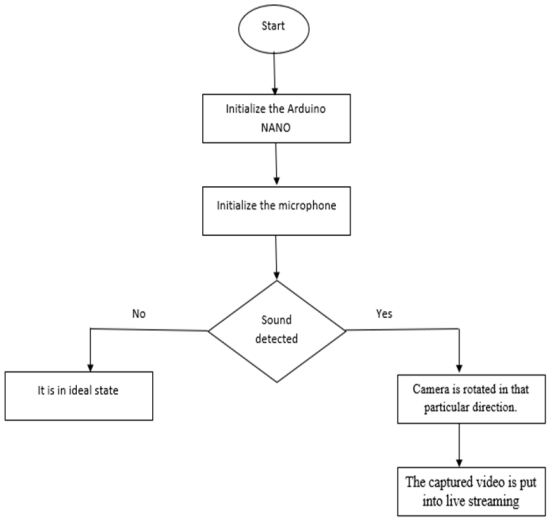


Fig.4. Flow diagram of proposed system

The proposed home surveillance system is based on a sensor network consisting of sound sensors, a camera module, and servo motors. The system uses sound technology to detect intruders and capture video of them in real-time. When a sound is detected, the robotic eye turns in the direction of the sound and captures video of the intruder using the camera module mounted on the servo motor. The video is then streamed live to the user's device through a Wi-Fi access point provided by the ESP32-CAM module. The user can then view the video and take appropriate action if necessary.

IV. RESULTS AND DISCUSSIONS

The ESP32 CAM responds to the sounds detected by the analog sound sensors on either side of the camera module. The ESP32 CAM rotates in the direction, in which it has detected the sound first and accordingly records the events [15]. The captured events are viewed as a live stream by connecting the ESP32 Camera module by keeping mobile data and hotspot on (Wi-Fi is inbuilt into the camera module) then powering up the kit and checking for IP address. Enter the IP address in the browser with the mobile device [14].

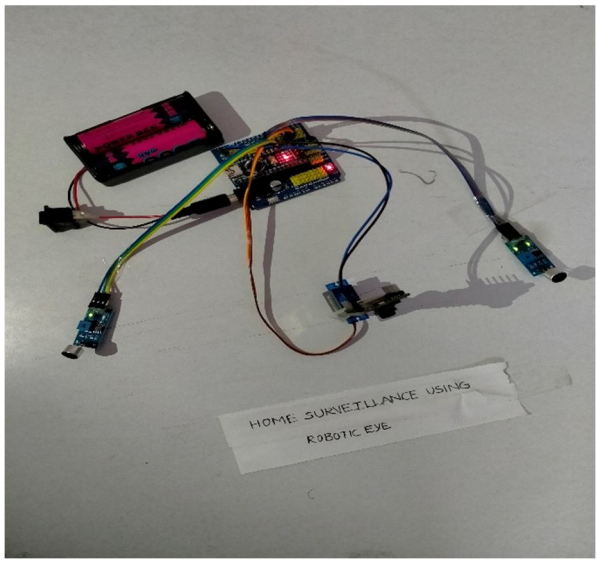


Fig.5. Top-view of the proposed system

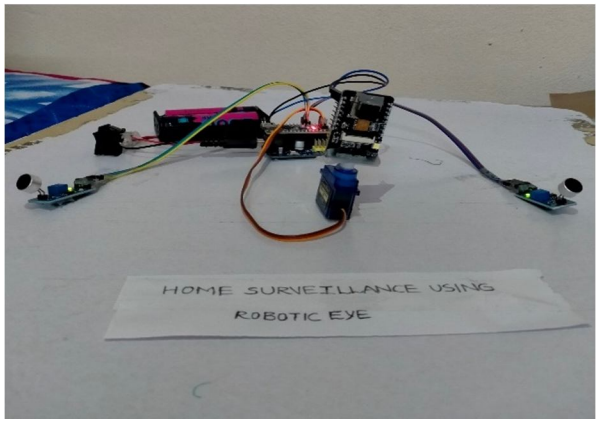


Fig.6. Front-View of Proposed System

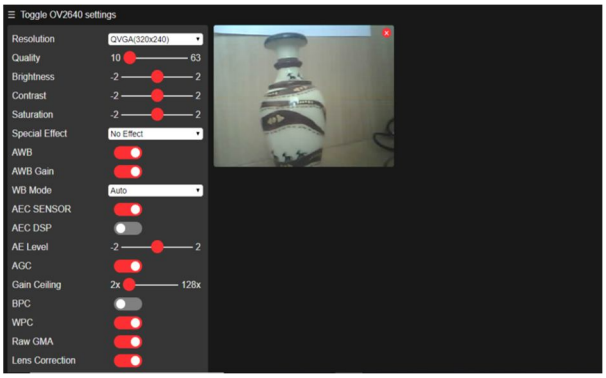


Fig.7. ESP-32 CAM video streaming set and simulation

1) D0 pin of sound sensor 1 is connected to D6 pin of Arduino Nano.
2) D0 pin of sound sensor 2 is connected to D7 pin of Arduino Nano.
3) 5V or V_{cc} pin of ESP32-CAM module is connected to A_{Ref} of Arduino Nano.
4) PWM pin of Servo Motor is connected to D3 pin of Arduino Nano.
5) All the Ground pins of all components are Grounded.

V. CONCLUSION

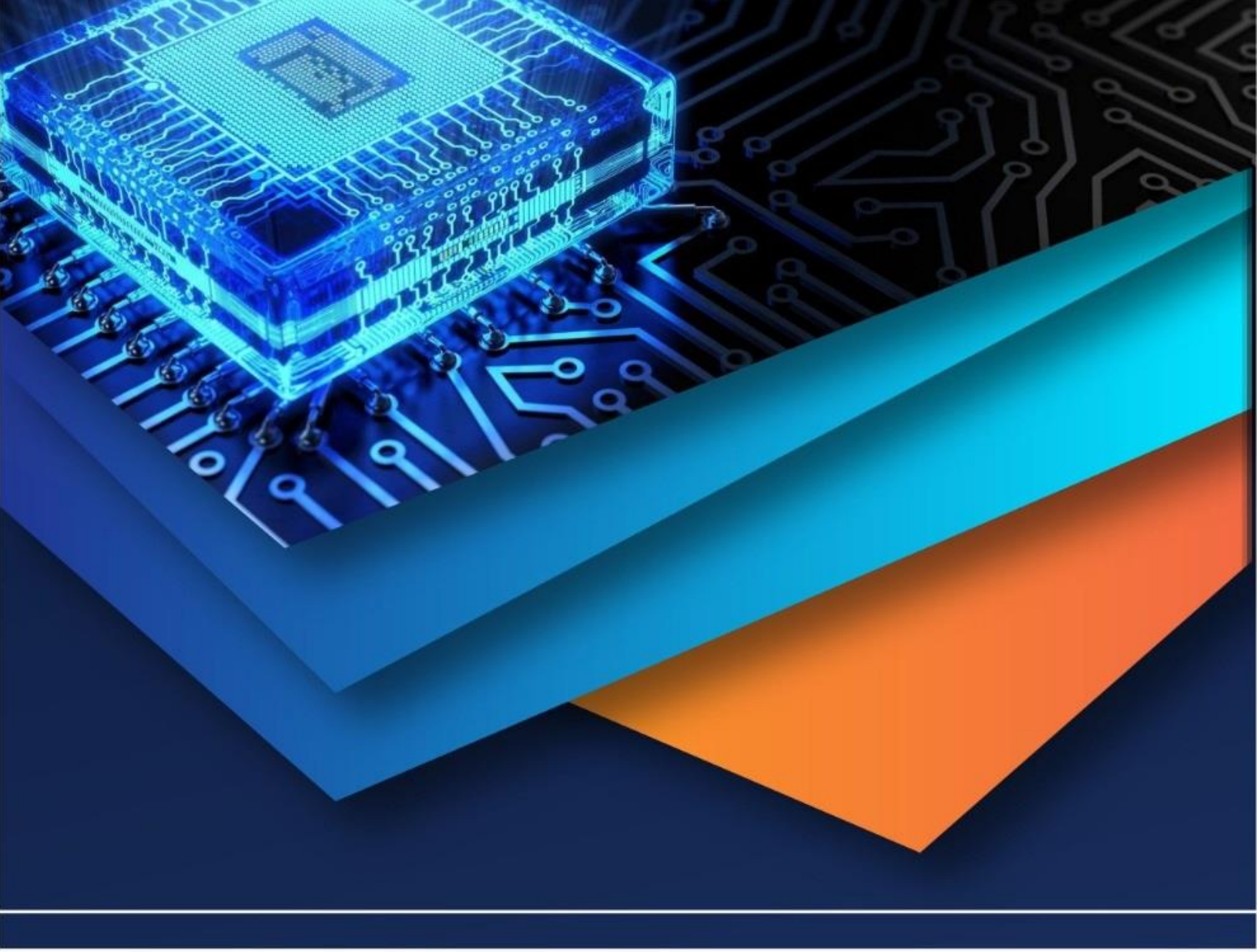
In this project, we proposed a home surveillance system using a robotic eye that uses sound technology to detect intruders and capture video of them in real-time. The system uses an Arduino Nano microcontroller, ESP32-CAM module, sound sensors, and servo motors to implement the proposed system. The system provides real-time surveillance and intrusion detection and can be used to secure residential properties as well as other establishments such as banks and museums. The proposed system provides a cost-effective and easy-to-implement solution for home security [5].

VI. FUTURE SCOPE

Home surveillance using a Robotic eye can be informed in the future by allowing the camera to switch on only when it detects sound by reducing the booting time required for the camera to switch on, this can be achieved by using a high-end camera whose booting time is relatively less [14]. Further, a GSM Module can be introduced into the system to receive an SMS as soon as the microphone detects sound. So here will be fast action that can be taken if one notices unwanted events taking place. Also, AI can be introduced into the surveillance system which provides the facility of recognizing and identifying human faces and objects [5].

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