Shield Buddy: Home security device using Esp32 and PIR sensor

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Abstract— In today's world, the need for surveillance devices at home has grown significantly. An immobile home surveillance system's goal is to improve the security and monitoring of a residential property by providing ongoing monitoring and warning residents or authorities of any unauthorized or suspicious activity. The main goal of this paper is to design and develop a system to control the camera using mobile phone remotely. The system comprises of ESP-32 CAM, a telegram bot and a PIR (passive infrared) sensor as main components. Compared to conventional security devices, the camera is OFF for majority of time, and gets ON while motion is detected. The system takes direct AC mains connection as power source. This system provides a very cost effective and power saving solution.

Keywords-Security, Internet of Things, PIR sensor, security systems, Shield Buddy.

I. INTRODUCTION

Security has never been more important in a time when the complexity of new threats is growing at a rate faster than technological advancement. Strong security solutions are now essential in our globalized society for a variety of reasons, including protecting vital infrastructures and guaranteeing people's safety. The need for creative approaches to protection grows as we navigate the difficulties presented by a changing landscape of risks. As technology becomes more and more integrated into our daily lives, the threats of home theft and cybersecurity breaches dominate our sense of security. The growth of networked devices in the cyberspace has created vulnerabilities that malevolent actors take advantage of for financial gain, data breaches, and even personal invasions. The possible effects of cyber threats go beyond the digital sphere and impact the very foundation of our homes and lives. Phishing attacks that target sensitive information and ransomware that infiltrates home networks are just two examples. Shield Buddy, the security robot sits at the crossroads of these issues, offering a comprehensive solution that addresses both cyber and physical security concerns.

II. LITERATURE REVIEW

There are various developments regarding the project being a remote-controlled mobile device that is controlled by mobile, as in paper 1 titled “Design and Analysis of IoT-Based Intelligent Robot for Real-Time Monitoring and Control”, there is a remote-controlled robot operated using raspberry pi using a wifi module. It uses the WoT (web of things) accompanied by multiple sensors. The proposed system has its own limitations, such as the system doesn’t use any inbuilt application to control the robot. Furthermore, the robot requires two DC engines to operate which is tedious to change or charge.

The paper titled “IoT Based Smart Multi Application Surveillance Robot” is all about developing a robot which can be sent into warzones to reduce human casualties [2]. A laser gun, metal detector and a GPS tracker is also equipped with the robot. This project is made and suited for the outer environment, especially border area, and is not suitable for home environment.

The mobile robot can be integrated with various sensors, as provided in the paper titled “Intelligent Surveillance Robot” in order to detect any combustible gas leakage [3]. The paper also provides facial recognition system and obstacle avoidance. The limitation that this paper proposes is that the robot cannot be remotely controlled, rather is connected to the computer using a series MAX-232.

The Esp32-Cam module also has micro-SD card slot, so that the images taken by the camera can be stored and accessed afterwards [4]. The paper provides a model which also uses pir sensor and the device goes into sleep and starts only when a motion is detected. The model provides a way to save the images in a micro-SD card [6].

The paper namely “Home Security System using ESP32-CAM and Telegram Application” provides us a method by which we can easily access the camera pictures using telegram application as the

name suggests. This enables the user to easily access the camera and there is no need for the user to download another application or as such for the same purpose [5].

The paper "IOT-BASED HOME AUTOMATION USING TELEGRAM USING ESP 8266" provides how ESP 8266 is connected to all other devices in home which can be accessed using telegram application. The paper also gives a comparison between ESP 8266 and ESP 32 [7].

The paper namely "Home Security System using ESP32-CAM and Telegram Application" proposes a system that secures a house by detecting an intruder in the building, triggering an alarm and capturing it all with camera images and then sending data to the owner's smart mobile [8].

The examined projects highlight advancements in remote-controlled mobile devices, spanning from home security to military surveillance. They employ various IoT technologies like Raspberry Pi, ESP32-CAM modules, and ESP8266 microcontrollers, coupled with sensors such as PIR sensors and facial recognition systems. Each project offers unique functionalities and limitations, emphasizing the evolving landscape of mobile device control and monitoring. Future research could focus on refining integration with existing technologies and exploring new applications to enhance security and automation across different domains.

III. METHODOLOGY

In order for the creation of an organized and economic solution to home security and surveillance system with remote camera control with a cell phone, following methodology was taken up:

HARDWARE IMPLEMENTATION

Following are the hardware components required

1. ESP-32 CAM

Figure 1. ESP 32 CAM

ESP-32 CAM is a low cost, low power consumption small sized camera module which is widely used in wireless video monitoring and Wi-Fi image uploading.

TECHNICAL SPECIFICATION

Processor: ESP32-D0WD-V3,

RAM: Internal 512KB + External 4M PSRAM

Power supply: 5V

Dimensions: 40.5mm x 27mm x 4.5mm

Output image format: JPEG (OV2640 support only), BMP, GRAYSCALE

Supported TF card: up to 4G

2. PIR SENSOR

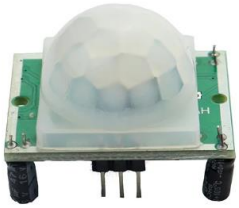


Figure 2. PIR Sensor

A PIR or a Passive Infrared sensor is an electronic component that measure the infrared light radiating from objects that emit heat in its vicinity.

3. DHT11 Sensor

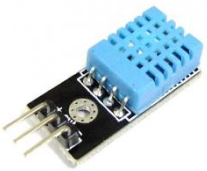


Figure 3. DHT11 Sensor

DHT11 Sensor is a low-cost digital temperature and humidity sensor which can be easily interfaced with microcontrollers for these readings.

4. BC547 transistor

Figure 4. BC547 transistor

BC547 is a NPN bipolar junction transistor used for amplification of the circuits.

5. FTDI232

Figure 5. FTDI232

FTDI232 is a FTDI device which is used for bridging USB to UART surrounding interface.

6. 220-ohm 0.25watt, 1k 0.25watt Resistors- Used for current control in the circuit

7. 1N4007 Diode – Is a rectifier diode with high current capacity and low voltage drop used for circuit protection.

8. LED 5mm – Two terminal red LED used for detection or presence of current in a circuit.

SOFTWARE IMPLEMENTATION

The ESP32-PIR sensor security system may be controlled by users on a recognisable and easily navigable platform by developing a Telegram bot for it. Users may effortlessly arm, disarm, and monitor the system remotely with simple commands, which improves convenience and usage. Using Telegram's secure messaging platform guarantees encrypted communication, protecting private data sent back and forth between the user and the device. All in all, integrating the bot guarantees secure contact with the security system, streamlines the user experience, and offers remote access.

To create the bot, users can initiate the process via BotFather (t.me/botfather) by clicking START and following the prompts to generate a unique bot name and username ending in "bot". Upon creation, users receive an HTTP API Bot token, which facilitates communication between the ESP32CAM and the bot. Subsequently, users can obtain their unique user ID by interacting with "myidbot" (t.me/myidbot) in the Telegram app.

Figure 6. Creating the bot for input of instructions

CIRCUIT DIAGRAM

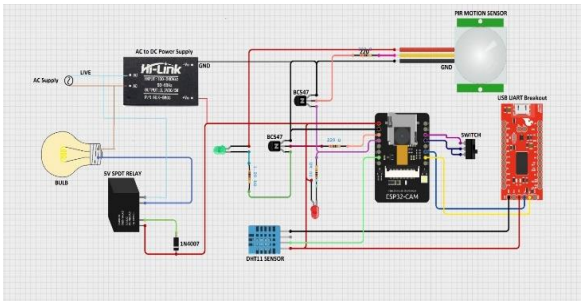


Figure 7. Circuit diagram of Shield Buddy

Firstly, an AC supply is given to AC to DC convertor, and the code is uploaded to the FTDI232 via connection cable. The FTDI232 then inputs the code in the microcontroller Esp32 cam, which in turn is connected to all the sensors.

The telegram bot is set up having necessary commands as /start, /photo, /weather, etc. Each command is then responded by the bot with the help of Wi-Fi and output is sent by esp32.

The hardware part is integrated with the cell phone using Wi-Fi and pre-existing application telegram, so that the user can input the commands from anywhere.

The PIR sensor was used with camera instead of conventional surveillance camera because it reduces the power consumption, compared to the surveillance camera which is turned on all the time, the PIR sensor turns on only when a motion is detected. Furthermore, it has adjustable sensitivity

and range and has consistent functionality irrespective of light conditions. It is cheaper and is passive, i.e, devoid of any radiation emission.

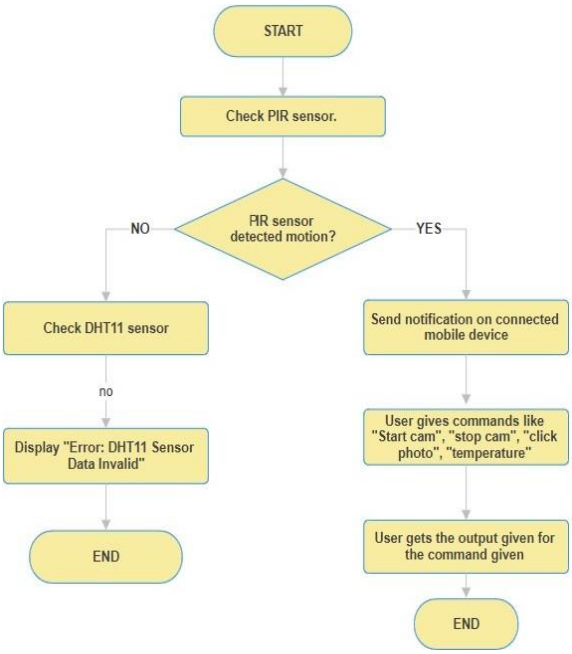


Figure 8. Flowchart for Shield Buddy

IV. RESULTS

Our project detected the incoming obstacle pretty accurately, and was able to click the photograph immediately.

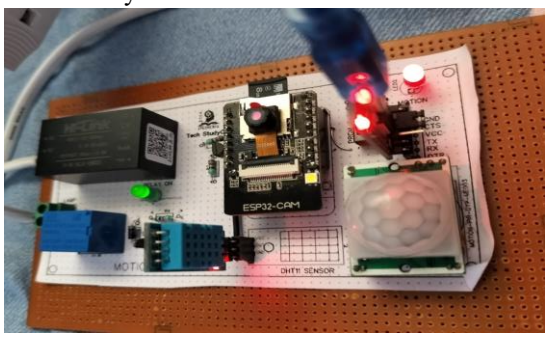
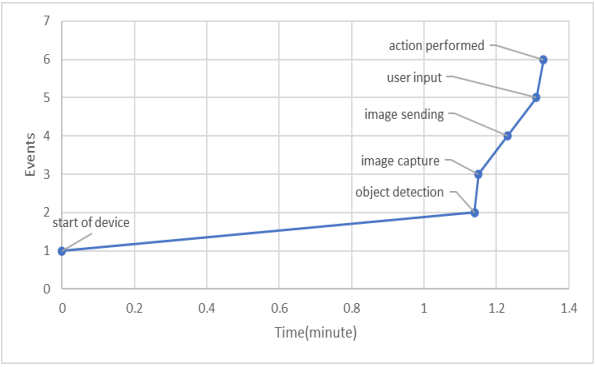


Figure 9. PCB implementation

The cost of production of prototype is 1170 rupees, that is the total cost of all the components. Hence, the total cost of prototyping and labour will be around 2000 rupees which is far less than the available surveillance products.

Table 1. Time Response graph of Shield Buddy



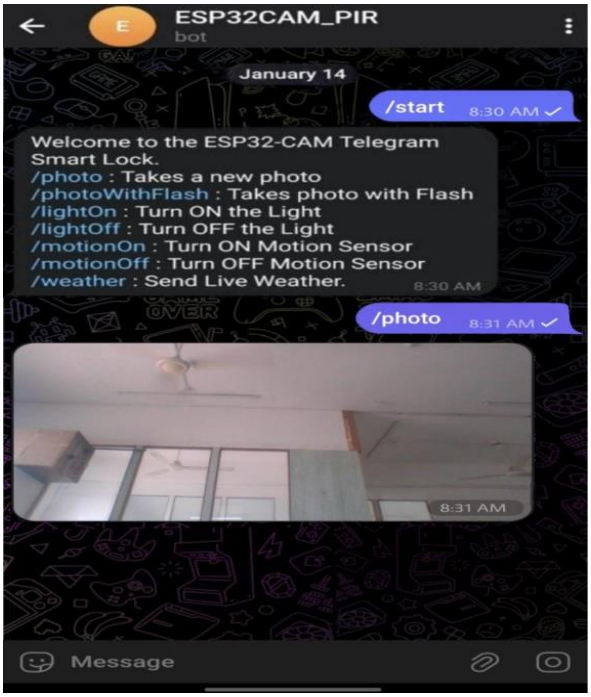


Figure 10. Results achieved from Shield Buddy

V. CONCLUSION

In conclusion, the integration of an ESP32-CAM module with a PIR sensor and the Telegram application represents a highly efficient and versatile security solution. Through the familiar Telegram interface, users can now remotely access and control their security system thanks to the combination of these technologies. In addition to providing real-time monitoring and notifications, this integration guarantees ease and enables users to react quickly in the event of motion or security breaches. The use of PIR sensor reduces the amount of power consumed by a full-time camera installed. Overall, the integration of the ESP32-CAM and PIR sensor with Telegram provides a complete security solution that blends solid security features, convenience of use, and remote accessibility, making it a great option for a variety of applications.

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