Enhancing Disaster Rescue
Autonomous Drone for Human Detection

Members involved:

Chandolu Sri Harsha – 22BCE8605

Krishna Mayurkumar Shah – 22BCE8184

Kushal Ramwani – 22BCE9320

Neelam Aditya Sai Manikanta Subrahmanyam – 22BCE7402

Nada Vivek Vardhan – 22BCE7383

Kashish – 22BCE8559

Under the Guidance of:

Dr. Misha Chandar Balachandar

SCOPE

VIT-AP UNIVERSITY, AMARAVATI,

ANDHRA PRADESH, INDIA - 522237

ABSTRACT

This report focuses on the development and implementation of an autonomous drone-based system called "HDD - Human Detection Drone." The system is designed to assist rescue operations during natural calamities or disasters by swiftly detecting and locating humans trapped under debris or affected by such catastrophic events.

The report begins by highlighting the challenges faced by rescue teams in identifying survivors and victims in disaster scenarios. It emphasizes the limitations of traditional methods and existing systems in accurately detecting humans amid complex debris structures.

The objectives of the HDD system are outlined, primarily emphasizing the need for an enhanced detection system to address the rising occurrences of disasters globally. The proposed methodology involves integrating an ESP32 microcontroller with a camera module and a Passive Infrared (PIR) sensor. The system aims to capture live video streams, detect motion, and perform facial recognition to identify humans within disaster zones.

The methodology further details the steps involved in configuring the ESP32, integrating the PIR sensor, activating the camera module, triggering image capture upon motion detection, live video streaming, motion analysis, and facial recognition using Python scripts.

The report discusses the successful integration of the PIR sensor and camera module, showcasing the system's ability to capture images upon motion detection and facial recognition. It acknowledges the system's overall success in achieving its objectives but notes occasional challenges, such as environmental interference affecting PIR sensor accuracy during testing.

In conclusion, the HDD system is deemed a promising solution due to its utilization of drones, which offer mobility and maneuverability in disaster environments where traditional robots may face limitations. It highlights the system's effectiveness in detecting humans during disasters like earthquakes and tsunamis, providing critical information to rescue teams.

The future scope section outlines potential enhancements, such as incorporating additional sensors, improving image quality, integrating with GIS software, extending battery life, implementing AI algorithms for object recognition, and enabling autonomous flight capabilities. The report concludes by referencing various research studies and articles supporting the efficacy of similar systems in disaster response.

The appendix includes code snippets (Python) illustrating the process of capturing images and detecting faces using the integrated hardware and sensors.

Overall, the report presents the HDD system as a viable solution for enhancing human detection in disaster scenarios, emphasizing its potential for saving lives and revolutionizing rescue operations.

INDEX

Introduction

Natural calamities have recently opened their doors to disasters which in turn have affected various regions of the world. Disasters serve as an eye-opener as they are unstoppable and exceptional events which are either natural or manmade, such as earthquakes, wildfires, floods and terrorist attacks etc. These natural catastrophes many a times serve as a hats down chink in the armor as they lead to a massive death toll either because of people being stuck in the debris or due to no help received on time. One of the major challenges faced by the rescue and search teams during a massive disaster is the actual search of survivors and victims at the earliest and also reaching out to far off areas to make sure people are not stuck under the debris. This paper presents a real time autonomous drone technology system named "HDD-Human Detection Drone" that is capable of detecting humans in disastrous conditions. This system assists in the rescue process by identifying the exact location of the survivors at the earliest. As the system is a drone based system, it can easily be mobilized and controlled. This system comprises of a monitoring system along with a camera module and sensor unit to identify the existence of humans buried under the debris. The system sends the data ahead for further action and investigation. We believe HDD system is the need of the time and will prove to be a blessing in disguise in calamitous situations and will serve as a significant requirement in urban disasters

Background

In disastrous situations like wars, tornados or earthquakes, one of the major challenges for the rescue and search teams is locating and finding survivors and victims at the earliest . However, in these cases rescue teams fail to sense the actual status of the life beneath the debris which finally leads to death. Moreover, disasters lead to such a devastating effect on the body which makes it further more difficult to differentiate between a human and material. This leads to a massive amount of people losing their lives; an uncontrollable situation.

Rescue teams in such situations are unable to reach certain sensitive areas due to the immense amount of debris. It becomes impossible for them to rescue people as they are unable to reach such areas. On the other hand, some existing systems that are controlled by robots are ineffective, because due to earthquake or any other disastrous condition, humans get stuck underneath the debris which makes it difficult for the robots to walk over broken and ruined buildings .
Due to all these problems, enforcement of a tailor made rescue framework is of prime importance.

The proposal of HDD has therefore been laid down in the light of all the issues. It is designed using drone which will enable it to overcome many of the disastrous problems. The system is capable of saving the lives of victims in real time. HDD rescue system will work efficiently in searching people trapped under the rubble and marking their locations as well as sending alerts, so that rescue teams can come in and aid those in need of assistance. The system gathers real time data day and night in challenging conditions and without any risk to personnel. It captures images and sends it further for monitoring the affected area. The system has Passive Infrared Sensors (PIR) to detect radiations generated by human body .

The project can be summarized as:

Human Detection drone can be used at the time of natural calamities to save the lives of humans for rescue purposes.This system is also useful for monitoring the affected area. This system can also provide aid to humans in areas where rescue teams cannot reach.

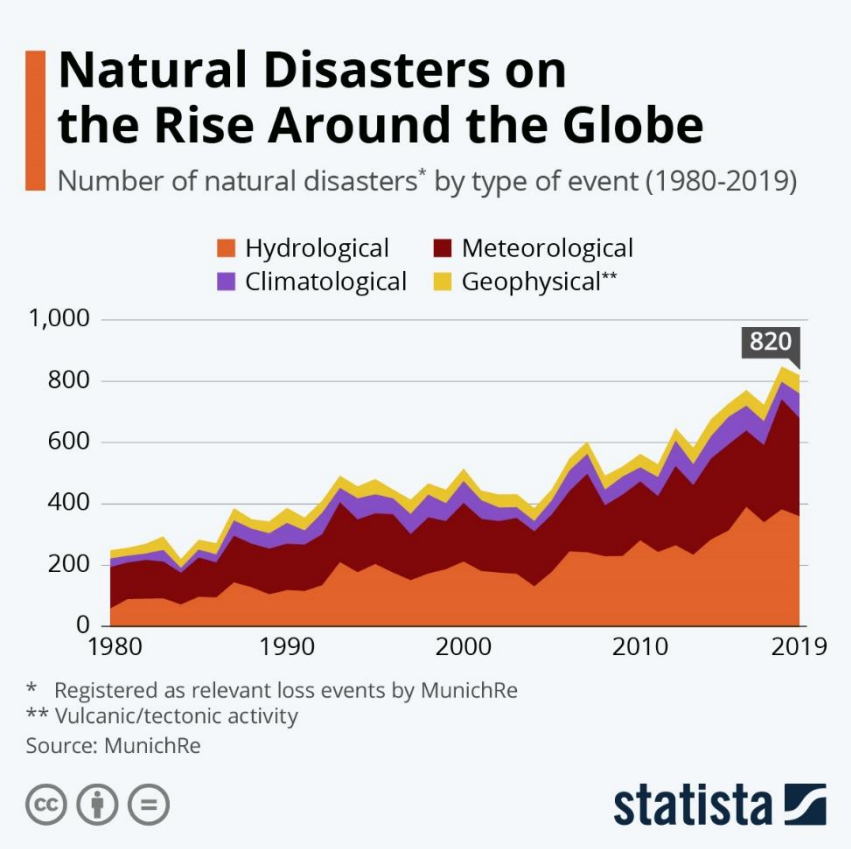
ProblemDefinition

In disaster-stricken environments, the imperative to swiftly locate and rescue individuals trapped under debris remains a critical challenge. Traditional search and rescue methods often encounter limitations in identifying humans hidden amidst complex debris structures. To address this, our report focuses on the pressing problem of enhancing human detection in disaster scenarios through the utilization of an innovative real-time autonomous drone system— HDD
The specific challenge involves seamlessly integrating Passive Infrared (PIR) sensors and cameras into the drone's architecture, enabling it to navigate and identify individuals beneath debris effectively. The urgency of this problem is underscored by the potential life-saving impact of rapid and accurate detection, crucial for expediting rescue operations and minimizing casualties in hazardous conditions.
"HDD" stands as a technological solution designed to revolutionize disaster response by combining cutting-edge PIR sensor technology with camera systems. This report seeks to evaluate the system's efficacy in simulated disaster scenarios, offering a comprehensive analysis of its design, functionality, and performance. The ultimate objective is to contribute to the evolution of human detection capabilities in disaster response, providing a tangible and transformative tool that significantly improves the efficiency and effectiveness of rescue operations in the face of complex and dynamic disaster environments

OBJECTIVES

The main objective of human drone detection system is to find humans who are stuck in various natural calamities we integrate the advanced facial recognition system along with the PIR sensor . This PIR Sensor Switch Can Detect the Infrared Rays released by Human Body Motion within the Detection Area (14 Meters).

the below graph shows the rise in the disasters around the globe with such a rise in the disasters we need to have a better detection system then the current system which helps is solving the problem much quicker this is the major objective of our project



[11]https://www.statista.com/

METHODOLOGY

The proposed human detection system aims to overcome the limitations of traditional methods to find humans setups by integrating an ESP32 microcontroller with a camera module and a Passive Infrared (PIR) sensor. The system combines real-time video streaming, motion detection, and facial recognition to create a more intelligent and targeted detection System solution. The following steps outline the methodology of the proposed system:

1 ESP-32 CONFIGURATION

set up the esp-32 as the micro controller with a compatible camera module

2 INTEGRATION OF PIR SENSOR

The main objective is to integrate the PIR sensor with the Esp 32 system to enhance the motion detection capabilities.

3 ACTIVATION OF CAMERA MODULE

Camera activating the camera module along with the ESP 32 and the wi-fi module.

4 CAMERA TRIGGERING AND CAPTURINF OF IMAGE

The next step in the process where we trigger the camera when the PIR sensor detects the motion the image is taken

5 LIVE VIDEO STREAMING

Implementing a video mechanism on the ESP32 to capture live frames from the camera module. Establish a communication link between the ESP 32 and the PC for transmitting video frames.

6 MOTION DETECTION

Develop an algorithm on the ESP32 to analyze video frames and detect motion using information from the PIR sensor.

Implement a mechanism to trigger captures and transmit frames to the PC where motion is detected

7 PC SIDE PROCESSING (Python Script)

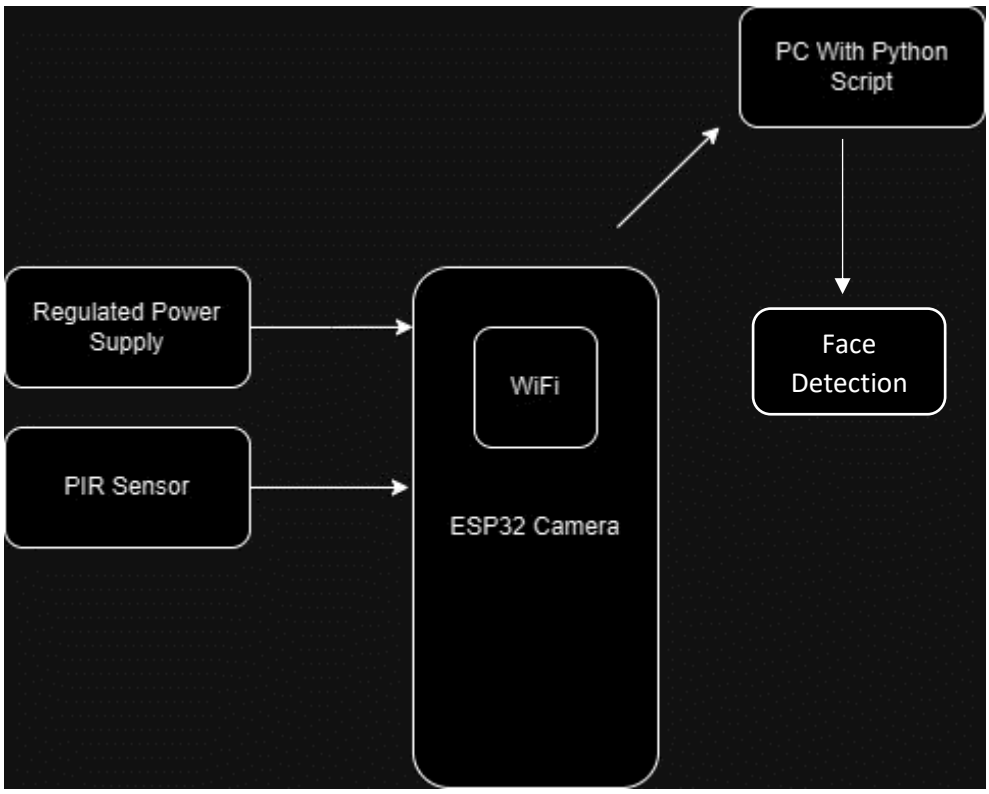
Create a Python script to receive and process the video frames from the ESP 32.Utlize the computer techniques to perform motion detection on the receive frames , minimizing false positives

8 FACIAL REGORNITION

Implementing a Haar Cascade classifier or a more advanced facial recognition algorithm in the python script to identify human faces within the frames.

IMAGE CAPTURE AND STORAGE

Save the images in a storage folder both the PIR sensor and the face detection make sure to save the images with time stamps.



RESULTS AND DISCUSSION

INTEGRATION OF PIR SENSOR

The PIR sensor has successfully integrated with the ESP – 32

ACTIVATION OF CAMERA MODULE

the camera module has successfully activated .

The entire system works successfully the camera is able to capture the live streaming and when ever the pir sensor detects any motion the frames are saved in separate folder with a time stamp PIR.jpg and even the face detection system works efficiently when even an face is recognized the same picture is saved in the folder with a different name.

The picture is taken when the system has detected an motion

The picture is taken when the face is detected as we can see the difference in the motion the entire frame is picked out where as in second frame only the face is captured which helps in better detection

The results indicate that the overall human detection drone system overall achieves its objective It demonstrated the feasibility and effectiveness of using a PIR sensor and camera for the detection of humans. Despite the overall success, some challenges were encountered during testing, including occasional environmental interference affecting PIR sensor accuracy

CONCLUSION AND FUTURE SCOPE

The Human Detection Drone system is built using Drone, minimizing the restriction of robots that can’t move much. The use of drone makes many situation easy for detection than robots

that have failed in disastrous conditions like the earthquake because when human is stuck under debris it makes difficult for robots to walk over debris and fallen building. It helps very much during Detection of people during Tsunami. Human Detection Drone is a real time autonomous drone technology system which is used to detect humans in disastrous conditions and give the information to rescue team about the effected human.

Many other sensors such as temperature and ultrasonic can be used in Human Detection Drone. Develop the capability to capture high resolution images with improved quality and details. Develop the compatibility with GIS software for seamless integration of captured data into mapping. Research and adapt to advanced battery technology to extend flight durations. Customize the drone ‘s capabilities to aid in search and rescue by adding features like thermal imaging for locating heat signatures. Ensure compatibility with existing aerial and ground based system for flawless coordination and information exchange. Implement artificial intelligence algorithms for real-time object recognition and tracking, enhancing the drone's ability to identify specific targets or anomalies in the captured images. Develop autonomous flight capabilities based on image analysis, allowing the drone to navigate complex environments without human intervention.

References

[1] M. Batty et al., “Smart cities of the future,” European Physical Journal: Special Topics, vol. 214, no. 1, pp. 481–518, 2012.

[2] A. Gupta et al., “Live Human Detection Robot,” International Journal for Innovative Research in Science (2014), vol. 1, no. 6, pp. 293–297, 2014.

[3] R. K. K, A. Meera, and N. Mathew, “Wireless Human Detection Robot,” ijraset.com, vol. 5, no. Iv, pp. 1584–1589, 2017.

[4] S. Ramesh and P. S. Yuvaraj, “Improved Response Time on Safety Mechansim Based on PIR sensor,” Ijetae, vol. 2, no. 4, pp. 292–296, 2012.

[5] T. B. Bhondve, P. R. Satyanarayan, and P. M. Mukhedkar, “Mobile Rescue Robot for Human Body Detection in Rescue Operation of Disaster,” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 3, no. 6, pp. 9876–9882, 2014.

[6] X. Jin, S. Sarkar, A. Ray, S. Gupta, and T. Damarla, “Target Detection and Classification Using Seismic and PIR Sensors,” IEEE Sensors Journal, vol. 12, no. 6, pp. 1709–1718, 2012.

[7] G. Bevacqua, J. Cacace, A. Finzi, and V. Lippiello, “Mixed-Initiative Planning and Execution for Multiple Drones in Search and Rescue Missions.,” Icaps, no. October 2016, pp. 315–323, 2015.

[8] A. Fernndez-Caballero, J. Castillo, J. MartnezCantos, and R. Martnez-Toms, “Optical flow or image subtraction in human detection from infrared camera on mobile robot,” Robotics and Autonomous **Systems**, vol. 58, no. 12, pp. 1273–1281, 2010.

[9] J. Lu et al., "The Smart Thermostat: Using Occupancy Sensors to Save Energy in Homes," Proceedings of ACM SenSys, vol. 55, pp. 211–224, 2010.

[10] V. Viswan and M. L. Madhav, "Mission-Critical Management Using Media Independent Handover," International Journal of Computer Applications in Engineering Sciences, vol. III, no. I, pp. 32–36, 2013

[11] https://www.statista.com/

[12] https://circuitdigest.com/microcontroller-projects/interface-hcsr501-pir-sensor-with-esp32#:~:text=Connecting%20the%20PIR%20sensor%20to,5V%20pin%20of%20the%20ESP32.

[13] https://randomnerdtutorials.com/esp32-cam-pir-motion-detector-photo-capture/

[14] https://youtu.be/LBoM_Uoq_nA?si=e-D60G9NqPCtrB1H

[15] https://youtu.be/LOqVIe9cnW8?si=6W-VF95aJ7Eg-S-e

[16] https://robocraze.com/blogs/post/all-about-esp32-camera-module

[17] https://flespi.com/blog/esp32-cam-motion-triggered-photo-mqtt

[18]https://forum.dronebotworkshop.com/esp32-esp8266/esp32-cam-and-am312-pir-sensor-newbie-issues-with-circuit/

[19] http://ieeexplore.ieee.org/document/8256877/

[20] https://ieeexplore.ieee.org/abstract/document/9673226/

Codes in Appendix:-

```
import numpy as np
import cv2
import urllib.request
```

```
import requests
def nothing(x):
    pass
# Define URLs for image capture and sensor data
url = 'http://192.168.29.46/cam-lo.jpg'
url1 = 'http://192.168.29.46/'
harcascadePath = "haarcascade_frontalface_default.xml"
detector = cv2.CascadeClassifier(harcascadePath)
sampleNum = 0
# Loop for image capture and processing
while True:
    img_resp = urllib.request.urlopen(url)
    imgnp = np.array(bytearray(img_resp.read()), dtype=np.uint8)
    frame = cv2.imdecode(imgnp, -1)
    response = requests.get(url1)
    pval = str(response.content).split(':')[1].split('}')[0] if ':' in str(response.content) else
    if pval == str(1):
        cv2.imwrite('PIR_' + str(sampleNum) + ".jpg", frame)
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    faces = detector.detectMultiScale(gray, 1.3, 5)
      for (x, y, w, h) in faces:
        sampleNum += 1
        cv2.imwrite(str(sampleNum) + ".jpg", gray[y:y + h, x:x + w])
    cv2.imshow('frame', frame)
    if cv2.waitKey(100) & 0xFF == ord('q'):
        break
```