INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 4 - V7I4-1481)
Available online at: https://www.ijariit.com

AI-based hexapod military robot

Srividya C. R.
c.r.srividya16@gmail.com
Global Academy of Technology, Bengaluru, Karnataka

Shreya Adiga H.
shreya.d.adiga@gmail.com
Global Academy of Technology, Bengaluru, Karnataka

Vaishnavi J. M.
vaishnavijm7@gmail.com
Global Academy of Technology, Bengaluru, Karnataka

Harshitha H. R.
hharshitha984@gmail.com
Global Academy of Technology, Bengaluru, Karnataka

Dipak Cumar V. C.
dipakcumar@gat.ac.in
Global Academy of Technology, Bengaluru, Karnataka

ABSTRACT

Hexapod walking robots have attracted considerable attention for several decades. However, only in the recent past efficient walking machines have been conceived, designed and build with performances that can be suitable for practical applications. Nowadays many expenses are made in the field defense on adopting primitive security measures to protect the border form the trespassers. Some military organization take the help of robot in the risk prone areas which are not that effective when done by army men. These robots are confined with the camera, sensors, metal detectors and video screen. The main objective of our system is to get automated gun targeting including some additional parameters like Wi-Fi module for real time data processed by the camera at the video screen and IR sensor to trace intruders. Thus, the proposed system using Wi-Fi reduces errors at defense and keeps the nation secure from the foe.

Keywords: *Artificially Intelligent robot, Military Robot, Surveillance, Raspberry Pi, Face recognition system*

1. INTRODUCTION

Ensuring border security is considered as an important aspect for any country. Activities like terrorist infiltration and illegal entry of living and non-living things is a big issue. It takes a lot of manpower and assets as the borders are stretched hundreds of miles and has extreme terrain as well as unfavorable conditions. Hence, the need of the hour is to design an automated border surveillance system with minimum human assistance.

Moreover, in case if something suspicious is detected by the system it must be able to take necessary decisions and hence take actions along with issuing alert messages for the human controllers. In case of any illegal entry of humans, system recognizes them as intruders, there by sends an intimation to control room and immediately targets them with a laser gun.

Landmine removal is a critical problem faced by many countries around the world. Therefore, it is an urgent issue to detect landmines in the ground and remove them safely. For safe detection non touch based detection methods are required. These methods involve the detection of landmines in the signals obtained by the non-touch-based sensors such as metal detectors and radars.

The proposed system in this paper is designed to achieve the following objectives:

1.1 Replacing the wheels machine mechanism

Legged robots can navigate on any kind of surfaces which is inaccessible for wheeled robots, wheeled robots are designed to work on prepared surfaces like smooth surfaces, roads, rails etc. Legged robots can jump or step over obstacles whereas wheels need to travel over it or take a different path. Legged robots help us in exploring human and animal locomotion. In our case, six legged robot(hexapod) offer greater stability while moving and standing. They can be perfectly stable on just 3 legs, The remaining legs of the hexapod offers a great deal of flexibility and increases its capability.

1.2 Face recognition system

The goal is to implement a system which deploys two processes of images such as input images and the image captured through live streaming. Both this process undergoes four common procedures face acquisition, preprocessing, face detection using haar cascade classifier and feature extraction using Linear Binary Pattern algorithm to compute LBP values. These values are stored in database only in case of processing an input image. Finally, comparison of the values in the database with the values computed via live streaming takes place which recognizes the human face as known or unknown based on the matching. In case the person is recognized as unknown the artificially intelligent system issues alert messages to the controller's Email with the

captured image. Also, the gun targeting system points the laser gun at the intruder.

1.3 Landmine Detection

The purpose of this feature is to safely monitor the situation where there are landmines placed like in such as border areas. The non-touch-based sensors are attached to the robot indicates if any mines are detected while the hexapod explores the border area around the borders and communicates with the controller by issuing alert messages (metal detected), Thereby protecting the lives present around the area.

1.4 Automatic gun targeting system

The prior concept of this feature is to detect and target the living object or any movement in border area by using automation. We used a motion tracking airsoft nerf gun for this project with two separate operation modes interactive and motion detection. Interactive allows u to control the gun remotely and stream live video. Motion detection uses open CV and computer vision to track moving targets in front of the camera. Using haar cascade face detection algorithm which easily identifies the person in front of the camera. In case the person is unidentified, the gun automatically turns on and continuously flashes on the intruder. simultaneously the image of the intruder is sent to the email.

2. SYSTEM DESIGN

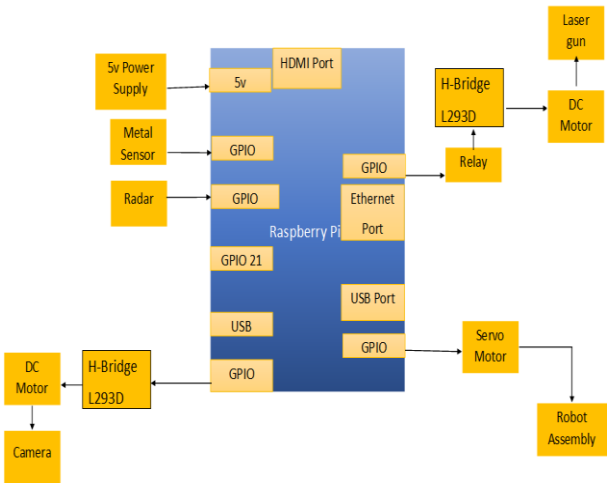

Fig. 1: Block diagram of defensive hexapod

Raspberry pi 3 has a built in Wi-Fi and Bluetooth module which can be used as a desktop computer to run any kind of program with Raspbian operating system installed. Raspberry Pi used for two modes of action. The remote-control mode, where the rover is controlled manually from remote device through the web server connecting it with an internet connection. This is done when the signal is passed from the Raspberry Pi and being master controls the movement of the rover. The movement of the robot is controlled with keys for all four directions besides with start and stop function in the web server. During autonomous mode the rover is programmed through the Raspberry Pi while the ultrasonic sensor detects in case of any obstacle and changes its direction accordingly. An H bridge is an electronic circuit that can control the motor of the robots in both directions. We will be using L298 H bridge IC. A pi camera module of 80fps is used which feeds its images in real time to a computer or computer network often via Ethernets or WIFI. Power supply used here has input voltage as 12V.An Infrared sensor is used for detection of moving object. It has a DC Operating voltage of 3.3V to 5V.It senses and indicates if any living or non-living object present in front of the robot. In order to trigger the laser we use driver relay. Here the relay we used has a supply voltage of 2.75V to 6V. About 3 servo motors are used for each leg of the hexapod robot. One for up and down movement, one for front and back, and other one for rotation. we have used two DC motors to which camera and laser gun is connected and this helps in easy rotation of camera and laser gun in both the directions.

3. FLOWCHART

This system is designed to track the object in real time and provide security by means of peripherals attached to this system. The working of the system consists of several steps which includes the processing of video signal from camera. The video is first converted into the raw digital format and then its luminance part is extracted by applying image processing algorithms. Then each frame is compared with the previous frame in order to detect the motion in the current frame. It is done by using background subtraction method. In this work, we applied scaling and smoothing techniques to remove noise and to improve the sharpness of the image. Then we calculated the difference image by subtracting the background information. Then the resultant raw binary image is further processed by using morphological operations which results in the detection of multiple objects. Then we applied blob analysis to connect all parts of the detected image. The next step was to determine the coordinates of the selected target which is achieved by sending the information to the microcontroller-based system which compares the coordinates of the current frame with the previous one. Micro controller then performs two functions: one is to activate the peripheral devices and the second is to take the decision in order to move the gun to the desired location. Once the target is selected, the microcontroller controls the movement of the gun by using the Dc motor. After the object is tracked, the decision shoots the target is achieved manually or automatically by using microcontroller-based system.

4. RESULTS

4.1 Known person Detection

The robot will be moving forward and exploring the region. If any object or person is detected IR sensor will turn itself on and there by camera will turn on to capture the face of the person and run it through the database. If the person face is matching with any of the face in the database, then the robot continues to move forward.

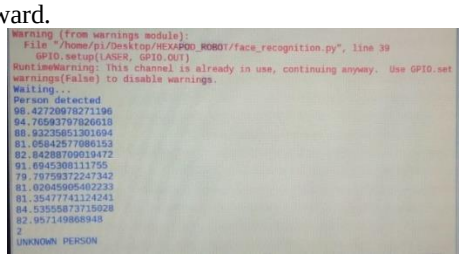

Fig. 2: IR sensor output

4.2 Unknown person detection

When the captured face doesn't match with any of the faces in the database the system recognizes him as known and automatically the laser gun will turn on which continuously flashes the light on the person. Also, an alert message will be sent to the controller's mobile phone and the captured image of the unknown person with be sent through an email to the controller.

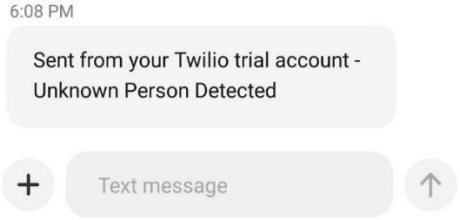

Fig 3: Message output

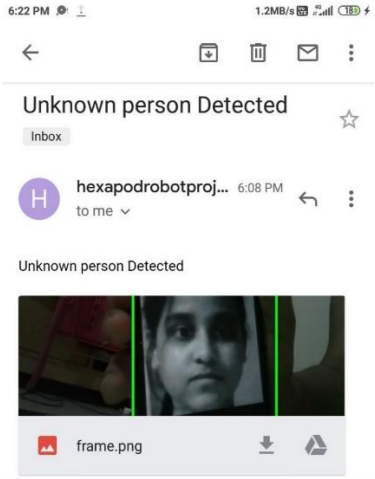

Fig. 4: Email with attachment

4.3 Metal detection

If the mental sensors detect any metal around the area over which it passes it indicates the user.

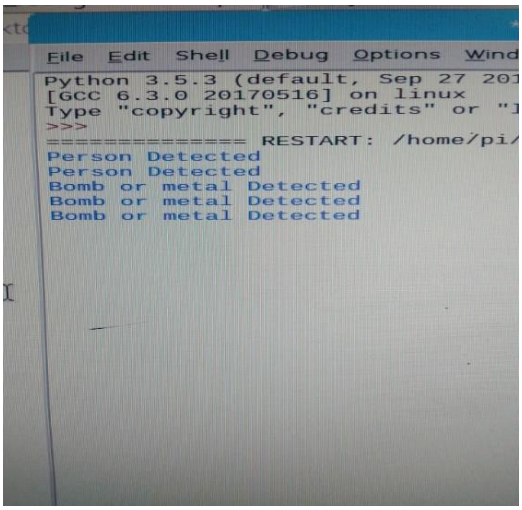

Fig. 5: Metal detection output

5. CONCLUSION

This project is feasible for highly secured area such as borders. It is small, lightweight and entirely battery operated. We created two separate operation modes: Interactive and Motion Detection. Interactive allows you to control the turret remotely and stream live video. Motion Detection uses OpenCV and computer vision to track moving targets in front of the camera. Algorithms for detection and identification using multiple features are presented and tested with various examples. Further a 360-degree rotating missile can be built over the robotic vehicle along with 4 ultrasonic sensors arranged in a square manner in order to shoot the object in any direction. Also, a 360-degree spy camera can be used for streaming entire area around the Bot.

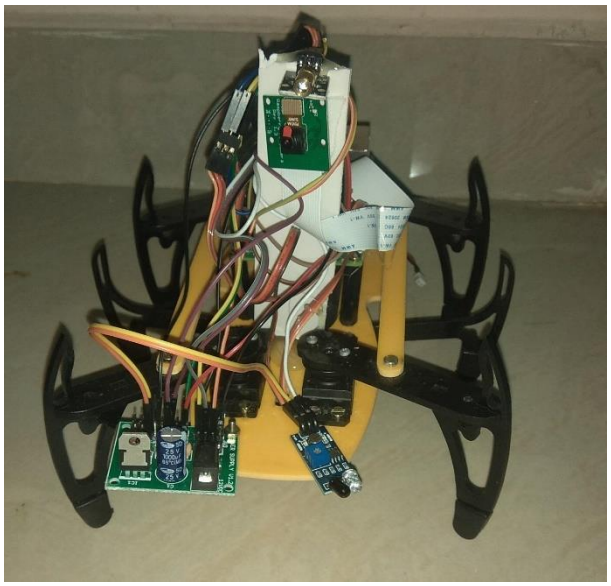

Fig. 6: Model of the Hexapod

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