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Design and Development of Patrolling Robot

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ABSTRACT:Robots are part of our day-to-day activities making everyone's life around us easier. Amid Pandemic, many people do not follow distancing rules even with much care taken and extra personnel appointed to get attention to such matters. Patrolling Robots can be implemented with unique modifications to this situation. Patrolling vehicles can patrol periodically in the designed area to ensure safety and avoid crowds, because of the pandemic such technologies will provide aid in crowded places creating awareness and ensuring safety. The proposed vehicle cannot only save manpower but also ensure performance without mistakes caused by man. It is different from the traditional patrolling system which is limited by manpower and fixed camera positions. This robot will be with the ability to detect obstacles in its way and make its route which will be an obstacle-free path. Development of a custom trained autonomous robot which is capable of optimizing its route through the input given by the user.

KEYWORDS:Patrolling-Robot, Human-detection, Route-Optimization, Autonomous Vehicle.

I. INTRODUCTION

Human security patrols can often become inattentive to details within the buildings as they become tired or bored. Humans can be put in harm's way should they be faced with a disease-affected person. To more effectively monitor buildings and keep human safety risks to a minimum, a new approach must be explored. In Pandemic Situation, People around crowd up places, such actions should be notified to the authority immediately to avoid future mishappenings to any lives and a patrolling robot should be able to handle this situation with real-time monitoring, patrolling the whole area and sending alerts when required.

Robots can be used as and more cost-effective solution to such problems where the least human involvement is needed. Robots maintain constant alertness without tiring or growing bored of their work. Due to their efficiency relatively low cost and ability to move rapidly through a known environment, robots are a cost-effective solution to monitoring buildings for such purposes and can protect valuable human lives. Some of these tasks have already been implemented, but this is the first time they have been brought together as one complete system.

Currently, the world is facing a pandemic to aid humankind many technologies are used to ensure safety. The proposed Robot has an Autonomous System and Human Detection based Crowd Alert System. It represents an approach to improving the autonomous vehicle system, which will provide on-demand services like transport and food delivery, etc. This robot will be with the ability to detect obstacles in its way and make its route which will be an obstacle-free path. Development of a custom trained autonomous robot which is capable of optimizing its route through the input given by the user. The Human Detection and Counting System through Webcam, Videos, or Images. The system will be used in Patrolling Robot to detect and count pedestrians, decide whether the place is crowded or not, and alert the authorities.

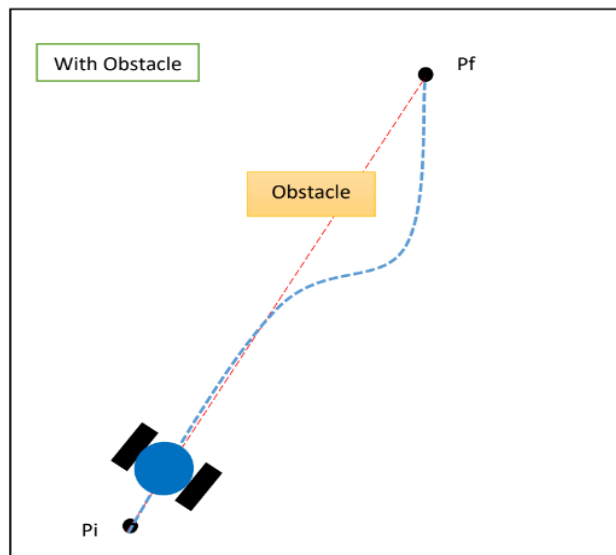
II. RELATED WORK

In the situation where least human involvement is required and where safer, efficient, cost-effective solutions are admired, robots are often been used. Robots can keep up constant alertness as they don't get tired or grow bored of their work or instruction given. Due to their efficiency, low cost and ability to move fast through a known environment, autonomous vehicles/robots are a cost-effective solution in monitoring buildings for such purposes and can protect valuable human lives. All of the obstacles have been tackled and some of those tasks have been implemented, but this is the very first time when all of it has been brought together as one complete system.

III. METHODOLOGY

Robot motor speed is control using PWM (Pulse Width Modulation) functionality available in the Arduino. It allows to partially powering the motor through controlling the duty cycle of the power signal. Robot motor speed is control using PWM (Pulse Width Modulation) functionality available in the Arduino. It allows to partially powering the motor through controlling the duty cycle of the power signal. Motor drivers acts as an interface between the two motors and control circuits. Motor require high amount of current whereas the controller circuit works on low current signals. L298 Motor Driver for the driving of motors, which operate on the Arduino signal, is used for prototype.

The set of the coordinate pass into the function which returns angular position over the robot rotate accordingly and linear displacement. After turn into a targeted direction, robots start moving in the forward direction. And every second the new position of the robot is to consider as the initial position and GPS coordinate of respective position send into the same faction to calculate the angular position and linear displacement. This loop continuously operates until the reach to the desired location.



While moving the ultrasonic sensor continuously bursts the signal as the object cone into the safe distance, the robot slows down the speed. Turn in the direction near to the final position. As the path is free from the obstacle start again operating on the above algorithm.

IV. RESULTS

DESIGN:

A 5 mm thick plastic board has been used to build the structure of the robot (dimension 18cm * 12 cm). Robot chassis is used as a mounting platform of hardware components. All the electronics hardware is placed on the platform. The robot motion is control through the 4 DC motors which operate on the Arduino instructions. These motors are attached to the chassis with the help of a motor bracket chip and tighten with the nut and bolt. On the top of the chassis, the Arduino board is mounted centrally. The GPS and Digital Compass are placed on the top chassis which is vibration proof to get accurate results. Raspberry Pi is mounted on the top for human detection, connected with Pi Camera which works with OpenCV, Python Image Processing. The battery is placed on the back motor so the steering can easily be done. The less weighted component is on the top layer of the robot platform so they get lesser magnitude of vibrations. The ultrasonic sensor is at the front side of the robot at the bottom layer for Obstacle Detection.

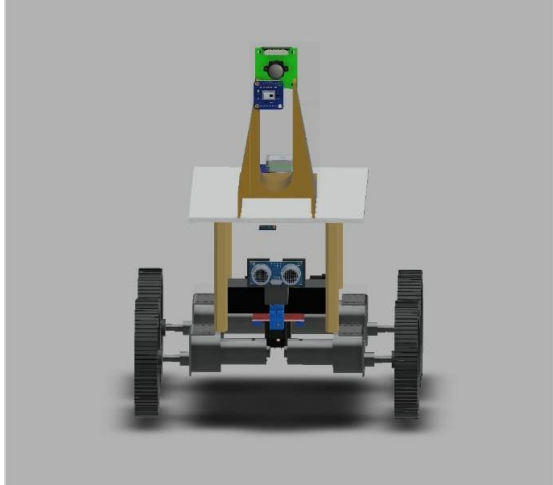


Fig. 1 Front View of Patrolling Robot

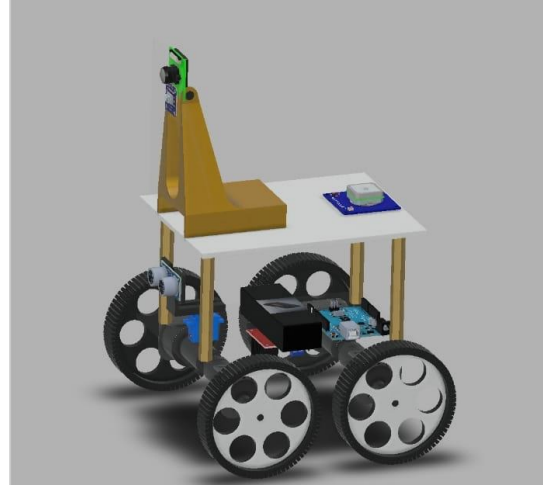


Fig. 2 Side View of Patrolling Robot

HUMAN DETECTION

Humans should be detected in given frame and count of their presence should be maintained in each frame to combine from a video.

Programming Logic: Select descriptor methods to define a good abstraction of the human model then set positive and negative training images to train a detection model, using a linear SVM classifier and Perform non max suppression to remove the noise and get a more accurate detection. The algorithm used in HOG descriptor combined with the SVM classifier. It is an object detection technique, which uses distribution of intensity gradients or edge directions to define the shape of an object.

When using the Histogram of Oriented Gradients descriptor and a Linear Support Vector Machine for object classification you almost always detect multiple bounding boxes surrounding the object you want to detect. Instead of returning all of the found bounding boxes we applied non-maximum suppression to ignore bounding boxes that significantly overlap each other.

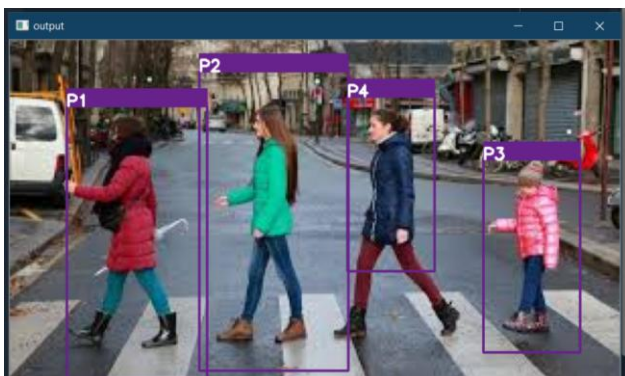


Fig.3 Output from Human Detection Algorithm Static Image Processed

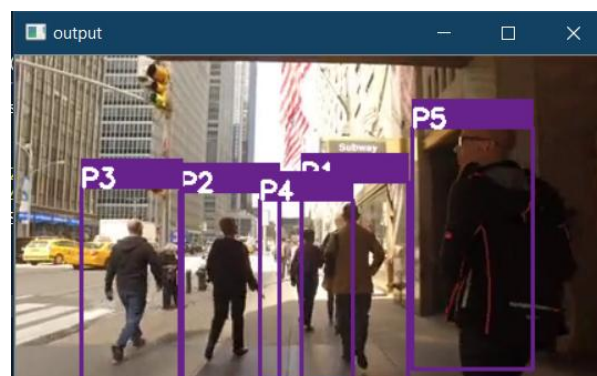


Fig.4 Output from Human Detection Algorithm Real-time processing On video

V.FUTURE ENHANCEMENT

1. Steering Mechanism for the proportional movement of wheels
2. Add Camera for object detection to increase accuracy
3. Web Application for user interaction with robot



4. Increasing Accuracy and Range of Human Detection
5. Recording Data

VI.CONCLUSION

Many areas of engineering to build a robot which has human detection and Path Planning Algorithm were explored. Using Mechanical aspect of engineering chassis which was vibration proof, stable and load sustaining was built. With Electronics aspect different tasks with processors and controllers like Raspberry Pi and Arduino. Many software and programming language like python and its libraries OpenCV, Numpy for Human Detection and were used for Autonomous Human Detecting Patrolling Robot. Additional Fine Tuning was done for Real World Scenarios considering how much error was there in them. Patrolling Robot is built combining different algorithms solving different test cases with one goal to create an alert system for crowded places for social distancing.

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