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**Title – Staircase detection for visually impaired people
Engineering Design and Innovation (EDI)**

BATCH – B3

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I. RELATED WORK:

In the paper, Staircase Detection to Guide Visually Impaired People: A hybrid approach, ultrasonic sensor, an R-GBD camera, a raspberry pi and buzzer are used where all this hardware is embedded on a walking stick. Camera sends its data to the CPU and the ultrasonic sends its data to raspberry pi through wifi. Faster-RCNN-Inception-V2-COCO model is used[1]. Another proposed system which also makes use of raspberry pi with an arduino. But here, The average accuracy and error rate obtained from the raspberry pi are 98.47% and 1.53% and with Arduino, 95.22% and 4.78% respectively. Here Raspberry pi obtained more accuracy and lower error rate than Arduino[3].

In the paper, Smart Cane For Visually Impaired Based On IOT, along with raspberry pi IR, GPS and GSM are used. GPS helps blind people to find the current location where a message is given through a headset[4]. In the system, Detection of manhole and staircase for visually impaired, detection range is 3-4 m[5].

Recently, a product which is in development called BrainPort (from Wicab Inc.) got approval for sale in Europe. It makes use of a camera mounted on a pair of sunglasses as its input device. But the system has a drawback that it requires continuous oral communication which disturbs other lingual activities[6]. Another one more system makes use of android application for object detection. In the proposed system, Raspberry Pi acts as a master controller and PIC18F4525 as a slave controller[7].

In the next system, components utilized are beat sensor, Light emitting diodes (LEDs), GSM module and headset. The system is organized into 6 modules[8]. P. Herghelegiu, et al. [9], introduces a stereo vision system to identify and track negative obstacles in front of the user.

Xuejia Rong et al.[10], proposed an indoor staircase detection algorithm based on RGB-D camera and by extracting a set of concurrent parallel lines based on Hough transform, and SVM-based multi-classifier is trained and tested. X. Huang et al. [11], proposed a technique for identifying stairs using the characteristics of a projection histogram. It first removes illumination from the staircase and finds the edges using directional Gabor filter and Canny edge detector.

S. Ponnada et al.[12], described a prototype using Arduino kit and a feature detecting module of mobility recognition utilizing feature vector identification and sensor computed processor Arduino chips. V. Singh et al.[13], worked on a shoe-based support system that uses IoT devices and computer vision algorithms to offer navigation, obstacle avoidance. And feedback determined by sensors and actuators.

B. Parabattina et al.[14], proposed the significance in autonomous robotic systems that require a stair detection module. The algorithm works on images and geospatial features. Stair detection is studied employing a neural network-based system. L. S. Desai et al.[15], described that Object detection is performed using statistical parameters, which is further validated using SVM algorithms. To increase the accuracy of object detection, ultrasonic sensors are employed.

J. Nivedha et al.[16], discussed the system includes the Raspberry Pi3, NoIR camera, earphones and power source. It collects the frames and converts them into voice. Shahrabadi et al.[17] explained the main goal is to extract the edges and to detect edge patterns which are approximately horizontal. In order to suppress noise, a frame has been filtered with a low pass kernel. G. Medioni et al.[18], approached using classifiers trained using Haar features and Adaboost learning.

Shuihua Wang et al.[19], proposed an RGBD camera to detect and identify stairs-pedestrian crosswalks. Applying Hough transform to extract parallel lines is running concurrently based on RGB channels, using SVM classifiers. Tomislav Galba et al.[20], discussed methods for staircase detection from video frames. It is based on vertical and horizontal examination of the frames and morphological preprocessing processes canny edge detector is used. Md. Nakibul Alam et al.[21], discussed staircase detection for blind people in navigation. The review describes sensors and extraction strategies for staircases using CV.

Shrugal Varde et al.[22] explained CV-based method to detect doors and stairs for indoor navigation. The images provided by stereo cameras used to extract information of segments that belong to stairs and doors. Stephen Se et al.[23] presented a texture detection method using Gabor Filters that is proposed to detect distant staircases. A homography search technique is used to estimate the staircase pose.

Kenta Imajo et al.[24] discussed an approach which detects plane areas at longer distances than white cane. By using SVM with a RGB image analysis, distance can be determined. Young HoonLee et al.[25] presented a real-time SLAM and dynamic route planning in the presence of obstacles using RGB-D as input. It outperforms using dense 3D point clouds and sparse features.

Ashwini Gaikwad et al.[26] explained about staircase detection for blind people. Quick R-CNN ResNet50v1 pretrained model is used for staircase-detection. For staircase-classification, VGG-19 pretrained model is used. Chen Wang et al.[27] proposed neural network architecture that regards the stair detection task as a combination of semantic segmentation and object detection.

A Stereo Vision based Algorithm is being discussed by Yaqi Li and Daniel Anguilera-Castro in their respective work [28][29]. In that Stereo vision was used to detect Staircase for visually affected peoples. After detecting it one must acknowledge people by assisting them through earphones. In [29] the author discussed Pothole Detection for the Drivers using Stereo Vision.

Another way of assisting visually affected peoples is by detecting small or Big Holes on the way. In [30] [31] Ramchandran Prakash and Mae Garcillanosa resp. suggested solution for pothole detection. Both have used Raspberry Pi Microcontroller, Image Processing and Computer Vision Libraries in their work.

Detecting Objects can also help some people and this work was done by Sumit Vaidya and others by using Machine Learning and YOLO Algorithm [32]. In [33] an outdoor navigational thing based on Hough Transform is proposed by Kazi Hasan Shakib to detect the correct zone for pedestrians and gives audio output to assist people. In that by using SIFT algorithm and Video

Processing they detected Objects for Blind ones [34]. In [35] a smart cane is used to assist blind peoples using Image Analysis. Another work in [36] authors discussed 3D Imaging used for Obstacle Detection for Pedestrians. Manuel Ramos Jr. and others have also discussed how one detects Road obstacles using LIDAR Sensors [37].

H. Matsumura et al.[38][39], aimed to identify the best accident prevention system and examined stair detection using deep learning. In the proposed system, Stair Climbing Robot Based on Convolutional Neural Networks for Visual Impaired, the robot consists of three main subsystems: mechanical, electronics, and control and vision[40].

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