IMPLEMENTATION OF ROBOT FOR ELDERLY ASSISTANCE USING AI APPROACH

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Abstract: *In India, the percentage of elderly people is 8% of the total population. Due to aging, all experience numerous health issues. On the other hand, sometimes they remain alone at home. Therefore, a little robot is designed and developed for Fall Detection and Pill reminder. Further, an Emergency Switch feature is provided to keep them healthy both physically and emotionally. The system is developed using Raspberry Pi. Where OpenCV source library is used to support computer vision, machine learning, and image processing functions. The CNN algorithm is implemented to carry out different tasks and activities. The computational time of 5 seconds is achieved to send cue mail to their kins. This will save the elderly from mishaps. The precision of detection is 95%.*

Key Word: CNN; *Fall detection; open CV: machine learning.*

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I. Introduction

The current system could have some drawbacks. As a result, there is room for improvement in the current research. The research conducted here used Image Processing and Machine Learning, which aided in the improvement of all previous research and provided a rapid and more accurate result for Fall Detection. Everyone, especially the elderly, deserves to live freely. In recent years, technology has focused on Elderly people to help them regulate their lives as effortlessly as possible. The main issues that older people confront in the post- retirement period are a lack of financial resources, poor health, a lack of emotional support, and disease.

All of these circumstances are intertwined or interdependent. In the background, steps are being conducted to investigate the proper status of care and support for all the elderly. In recent years, technology has paid special attention to old people to help them govern their lives as effortlessly as possible. As a result, work is presented to assist the elderly, with the main goal of detecting whether the person is standing or falling and informing the person nearby or away through the mail. Additionally, the pill reminder system and the emergency switch button worked flawlessly, and the speaker is used for audio output.

There are numerous systems on the market, but either they are prohibitively expensive or they do not address the fundamental issue that the elderly face. When it comes to the older people in the hamlet, they don't have enough money or family members to pay for such expensive equipment for their care. Also, such organizations do not have the means to purchase such a piece of high-cost equipment, especially in old-age homes where a large number of people dwell. This project has primarily concentrated on the people who live in the village, taking into account how much money they have available to invest, and after conducting the extensive study, it has been developed which is cost-effective, simple to grasp, and easy to implement. This paper consists of 4 sections. Section 1 provides an overview of the project's theme. The approach used to design and construct a robot is described in Section 2.Results are elaborated in detail in section-3 followed by the

discussion in section-4 and conclusion in section 5.

Ⅱ. Design and development of an AI-based robot implementation methodology

In simple words, this method detect movements and then extracts the movable object, extract various factors such as aspect ratio, orientation angle, centroid, and Hu moment in variants, to detect whether or not a fall has occurred based on the threshold determined during experimental analysis, and finally sending an email notification. Python is the programming language used. A speaker is also connected to the system, which will serve as a reminder for various activities. The emergency switch will also act in tandem with the speaker, generating a voice note "help me" when the switch is pressed. A zero PCB is used to do this purpose.

Figure No- 1 : System Block Diagram
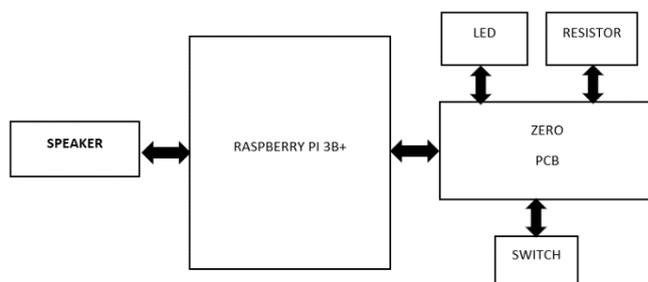
1)

2)   Block diagram:

The Raspberry Pi 3B+ is powered by a 5v,2.5A adapter, and a speaker is attached to the audio-video composite 3.5 mm socket. A VGA to HDMI cable is linked to the Raspberry Pi's normal HDMI port, and the zero PCB and switch are linked to pins 10 and 12 of the 40 GPIO pins. On the zero PCB, a LED is connected.

Fall Detection:

Flow of fall detection system is shown below:

Figure No 2: Fall Detection system flow
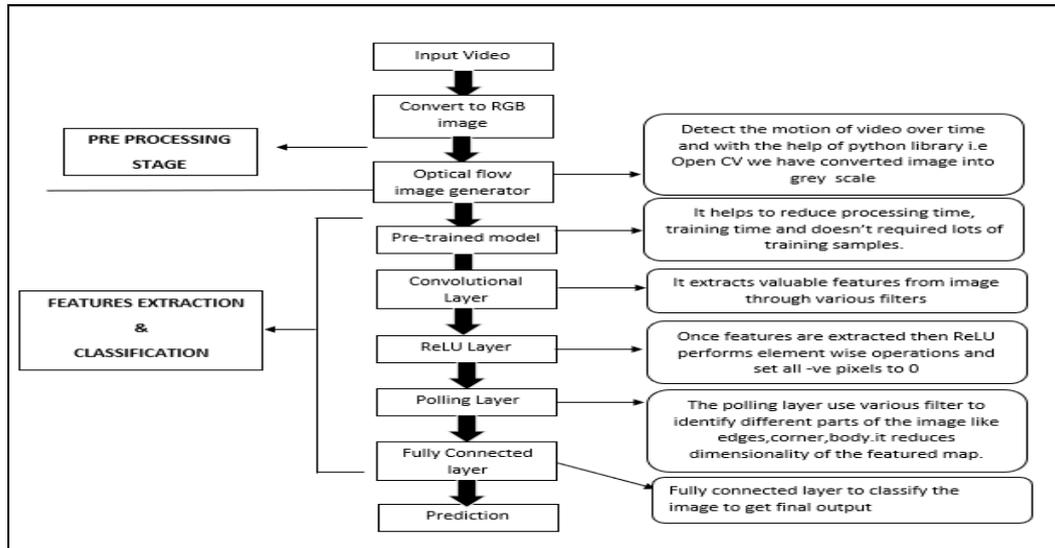
CNN has been always use for the automatic feature extraction process, it helps to reduce the number of hand-engineered image processing steps. CNN can learn the set of features that best suit a given situation. Additionally, CNN are particularly useful tools for achieving general characteristics. Network settings and training procedures must be fine-tuned for this. Because time management is so important in fall detection, CNN needed to include a means to deal with time and motion.

Optical flow images are used to detect the motion of two continuous frames, which is not enough to detect the fall However, by togethering them, the network can get longer-time related features. These features were given as a input to, a fully connected neural network (FCNN), which gives output as a "fall" or "no fall" signal. The Optical flow image generator is a programme that generates images based on optical flow. The optical flow algorithm encodes object motion patterns as displacement vector fields between two successive images. By stacking 2L optical flow pre-trained models are used as it helps to reduce the processing time, training time and doesn't required lots of training samples. Once the features are extracted using the convolution layer, the ReLU layer performs the element wise operations and set all the -ve pixels to zero.

Following the convolutional layer, a pooling layer is added. The convolutional layer's output is given as an input to the pooling layer. The pooling layer does the operation of down samples the image, which results in reduced dimensions while maintaining critical information. Memory requirements are also lowered in this manner. It extracts additional features and detects multiple image components such as edges, corners, and so on. It transforms the corrected feature map matrix into the pooling feature map matrix.

The fully connected layer is used to connect every neuron in one layer to all the other layers present in another layer. This layer is used to classify the image and get the final output

Algorithm: Fall Detection
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Input: Video file
Output: Detection of whether the person has fallen or not
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 1: Initialize the system

2: Input the video

3: Verify the information into the database

4: Perform Fall segmentation and classification methods.

5: To detect a Person Fall with the help of pre-processing, segmentation, feature

extraction Perform optimization lastly classification, after that pre-processed image are used toclassify the this

6: Evaluate the system performance in terms of accuracy and computational time.

7: Initiate the process of sending alert to the registered email id

8: Stop the process

3) DAILY ROUTINE REMINDER AND EMERGENCY SWITCH PROGRAM FLOW:

4)

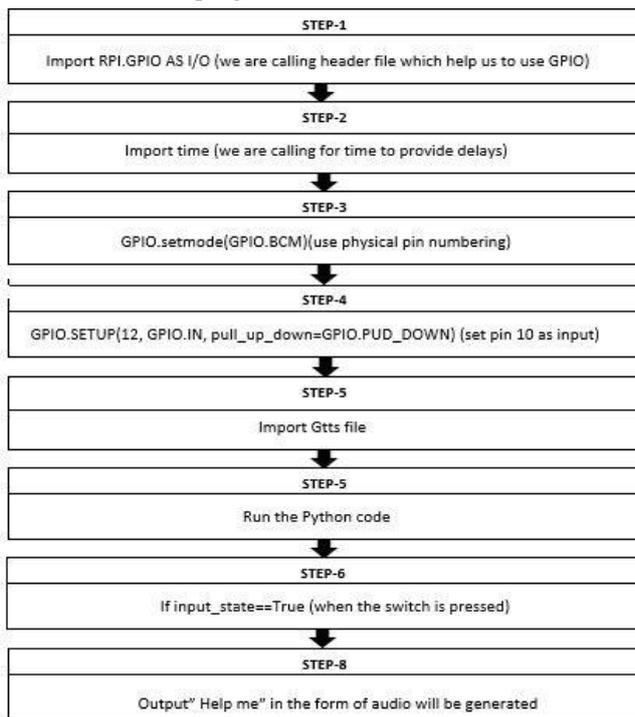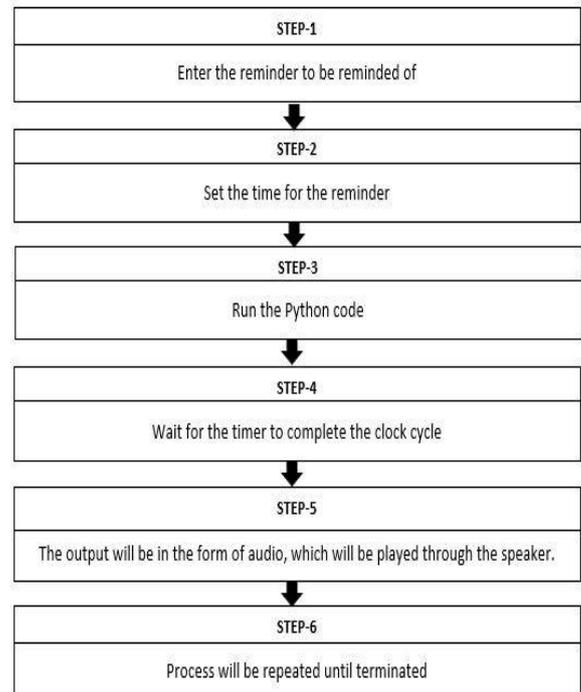**Figure No 3: Emergency** switch program flow   **Figure No 4**: Daily routine reminder program flow

The program flow of daily routine reminder is quite simple, in the code enter the reminders to be reminded of, after that input the time span in which the system should be repeating the reminder. Run the code and wait for the clock timer to complete the clock cycle, after the clock cycle is completed, the output will be generated in the form of voice through the speaker. A voice file has been imported in the program.

In the emergency switch program flow, The RPI.GPIO API library is used in launching input and the output pins .This library is available on Raspbian operating system by default. In the next step Import time

library is used for calling delays in the program. GPIO.setmode(GPIO.BCM) this library indicates whether the GPIOs are addressed via board numbers or via GPIO number. GPIO.setup library is used to set a port/pin as output. gTTs library is used to convert text to speech. Next step is to run the python code. When the switch is pressed an signal is generated which activates the pin and output "help me" in the form of audio is generated.

Ⅲ. Result and Discussion

This paper successfully demonstrated fall detection, daily routine reminder, and emergency switch function. The result of the fall detection system is shown in Fig. 5 and Fig. 6. The results of the emergency switch and daily routine reminder as output is in the form of audio. In this paper, Robot is designed with the help of Raspberry board.

Figure No 5: Person walking   **Figure No 6:** Person Fallen

After the fall detection is detected ,with the use of python code which has been written to send the mail to the registered person an email will be send regarding the alert that the person has fallen and requires urgent help. The alert mail received has been shown in the below figure.

5)   Email received regarding the fall detection :

Figure No 7: Alert email received from the system
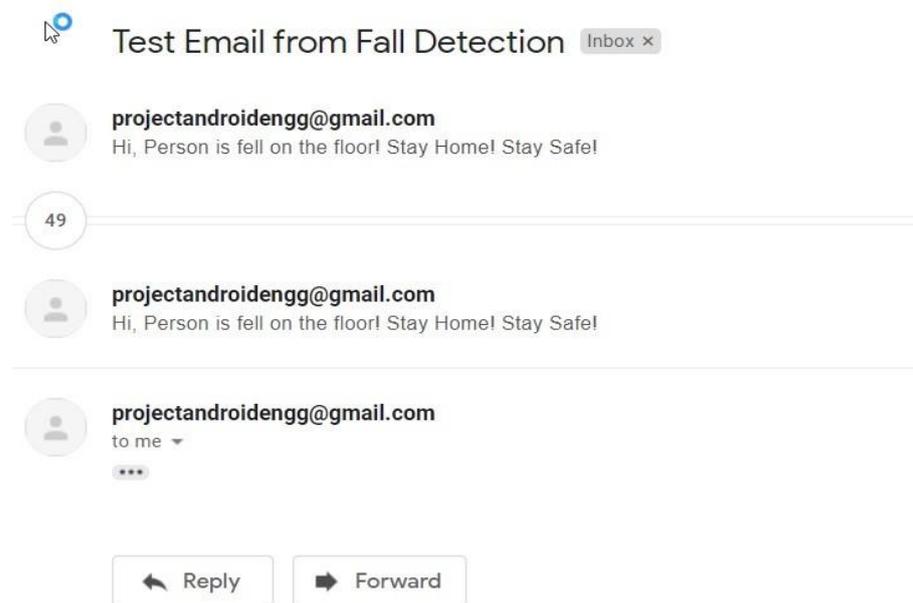
In this paper, Robot is designed with the help of Raspberry 3B+, many other Raspberry models like Raspberry Pi 3, Raspberry Pi 3B+ etc. are available. The features considered in the designing system is satisfied by Raspberry Pi 3B+, as it has higher a ethernet base, 3B+ has a clock over the speed of 1.4 GHz, Raspberry Pi 3 does not have power over ethernet but 3B+ has power over ethernet which is very helpful, easing power control as there's no need for writing in any sort of switch or relay now.

Table no 1: Comparison of Raspberry PI 3 and PI 3B+

RASPBERRY PI 3	RASPBERRY PI 3B+
It has a processor: Broadcom BCM2837 Soc@1.2GHZ	It has a processor: Broadcom BCM2837 Soc@1.4GHZ
Ethernet: 100 base	Ethernet: 1000 base
PoE: NO	PoE: YES
WiFi:802.11b/g/n	WIFI: Dual-band 802.11 ac

IV. Conclusion

In this paper, a low-cost elderly assistance robot is designed and tested. A Raspberry Pi-based system is proposed to provide an internet interface in terms of emergency. Following are the observations:

1)   This system, provides a detection accuracy of 95%.

2)   A vision-based approach is found to be best for visual detection using a single RGB camera but it increases computational time

3)   Different fall detection systems are available with different technologies but the use of IoT-based approach in this system notifies the user much faster.

References

[1]   Guo, Y., Liu, Y., Oerlemans, A., Lao, S., Wu, S., & Lew, M. S. (2016). Deep learning for visual understanding: A review. Neuro computing, 187, 27-48.

[2]   M. M. Abu Ghosh and A. Y. Maghari, "A Comparative Study on Handwriting Digit Recognition Using Neural Networks," 2017 International Conference on Promising Electronic Technologies (ICPET), 2017, pp. 77-81, Doi: 10.1109/ICPET.2017.20.

[3]   J. Yang and J. Li, "Application of deep convolution neural network," 2017 14th International Computer Conference on

Wavelet Active Media Technology and Information Processing (ICCWAMTIP), 2017, pp. 229-232, Doi: 10.1109/ICCWAMTIP.2017.8301485.

[4]   J. Santiago, E. Cotto, L. G. Jaimes and I. Vergara-Laurens, "Fall detection system for the elderly, 2017 IEEE 7th Annual Computing and Communication Workshop and Conference (CCWC), 2017, pp. 1-4, doi: 10.1109/CCWC.2017.7868363.

[5]   Cheng, F., Zhang, H., Fan, W. et al. Image Recognition Technology Based on Deep Learning. Wireless Pers Commune 102, 1917–1933 (2018).

[6]   X. Wang, L. Gao, J. Song and H. Shen, "Beyond Frame-level CNN: Saliency-Aware 3-D CNN with LSTM for Video Action Recognition," in IEEE Signal Processing Letters, vol. 24, no. 4, pp. 510-514, April 2017, Doi: 10.1109/LSP.2016.2611485.

[7]   Makrand M Jadhav, Gajanan H. Chavan, and Altaf O. Mulani, "Machine Learning based Autonomous Fire Combat Turret", Turkish Journal of Computer and Mathematics Education, Vol.12 No.2 (2021), 2372-2381, https://doi.org/10.17762/turcomat.v12i2.2025