Visual Fire Detection and People Density Monitoring System

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AGENDA

- *Problem Statement*
- *Survey*
- *Abstract*
- *Literature Review*
- *Proposed Features to be incorporated in the final Prototype*
- *Block Diagram*
- *Flowchart*
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- *Architecture*
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PROBLEM STATEMENT

Fire incidents have a huge damaging impact on human life as well as property in residential and industrial areas. On the other hand, the risk of fires is growing in conjunction with the growth of urban buildings due to increase in population and lack of ventilation. Traditional fire detection equipment's have a chance of failure and also have a high possibility of giving false alarm moreover they cannot give dynamic attributes like number of people trapped in fire and the intensity of fire. One of the major problems among fire fighters is to find the number of trapped people in the building among all the smoke generated in fire

ABSTRACT

In this project, we propose an architecture using raspberry pi and a camera to provide an accurate number of people trapped in the building and moreover, find the location of trapped people and detect fire using, deep neural network (DNN) models, i.e.,InceptionV3 which are embedded in the vision node which is the camera and raspberry pi. We also use HOG descriptor algorithm to find out the estimated number of people trapped inside the whole building. A web application is developed and integrated with the vision node through a local server for visualizing the real-time events in the building related to the fire and getting the count of people. In this proposed system concentration on sensors are omitted with the usage of Inception v3, a widely-used image recognition model that has been shown to attain greater than 78.1% accuracy. In the proposed system, a webcam is used instead of a surveillance camera for convenience .

LITERATURE REVIEW

S.No	Title of Papers and Authors	Year	Existing Work
1	**Fire detection using smoke and gas sensors** Chen, S. J., Hovde, D. C., Peterson, K. A., & Marshall, A. W[IEEE]	2007	Fire detection can be delayed due to smoke generation and detection time, leading to damage before prevention measures can be taken.
2	**Novel method of real time fire detection and video alerting system using open-cv techniques** M. Karthikeyen, N. Ramya, M. Sai Priya and C. Yuvalakshmi[MDPI]	2021	Fire detection and giving alerts using mailing system which is a very traditional way and it is not sustainable
3	**Fire Detection Using Deep Learning And Opencv** Vinaya Gawali, Saloni Pawar, Muskan Chhangani,Arsh Shrivastava,K.A. Kalokhe []	2022	The system uses advanced Deep learning and Convolutional Neural Networks technology to detect the fire and OpenCV technology to capture the images

MODULES OF PROJECT

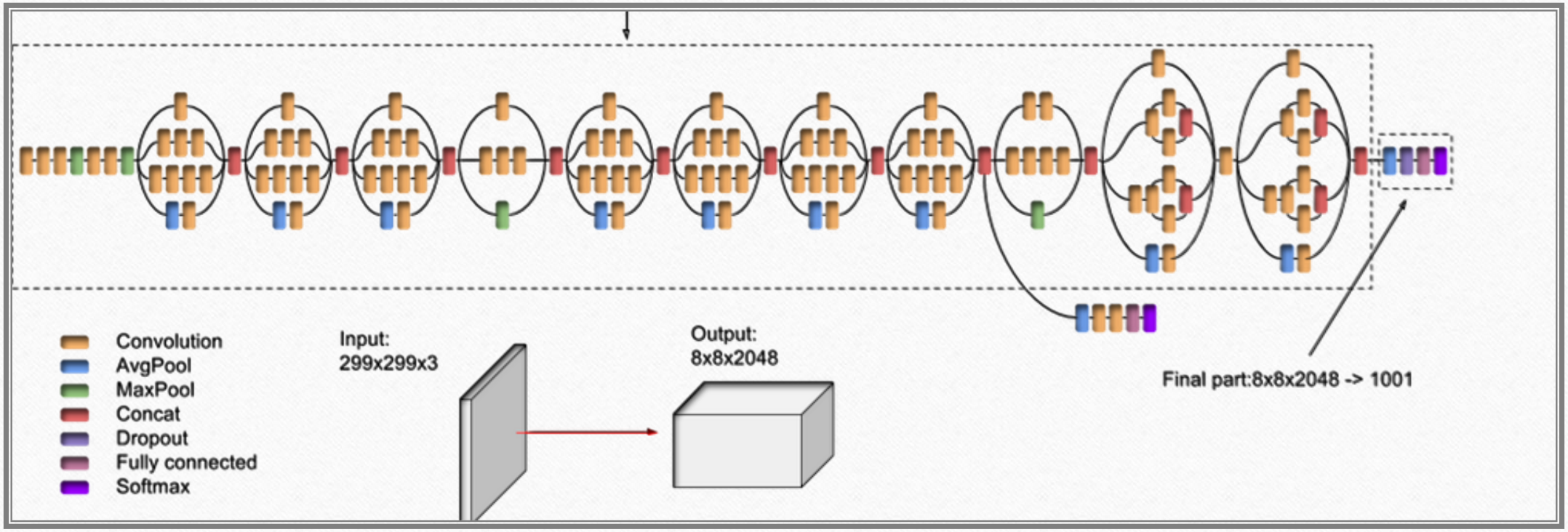
- ***Fire Detection***

This system utilizes the Inception V3 model which is made up of symmetric and asymmetric building blocks, including convolutions, average pooling, max pooling, concatenations, dropouts, and fully connected layers. Batch normalization is used extensively throughout the model and applied to activation inputs. Loss is computed using Softmax activation function.

It has a deeper network compared to the Inception V1 and V2 models, but its speed isn't compromised.

The Inception V3 model used several techniques for optimizing the network for better model adaptation. It has a deeper network compared to the Inception V1 and V2 models, but its speed isn't compromised. It is computationally less expensive. It uses auxiliary classifiers as regularizes.

A high-level diagram of the model is shown:


Convolution
AvgPool
MaxPool
Concat
Dropout
Fully connected
Softmax
Input:
299x299x3
Output:
8x8x2048
Final part:8x8x2048 -> 1001

MODULES OF PROJECT

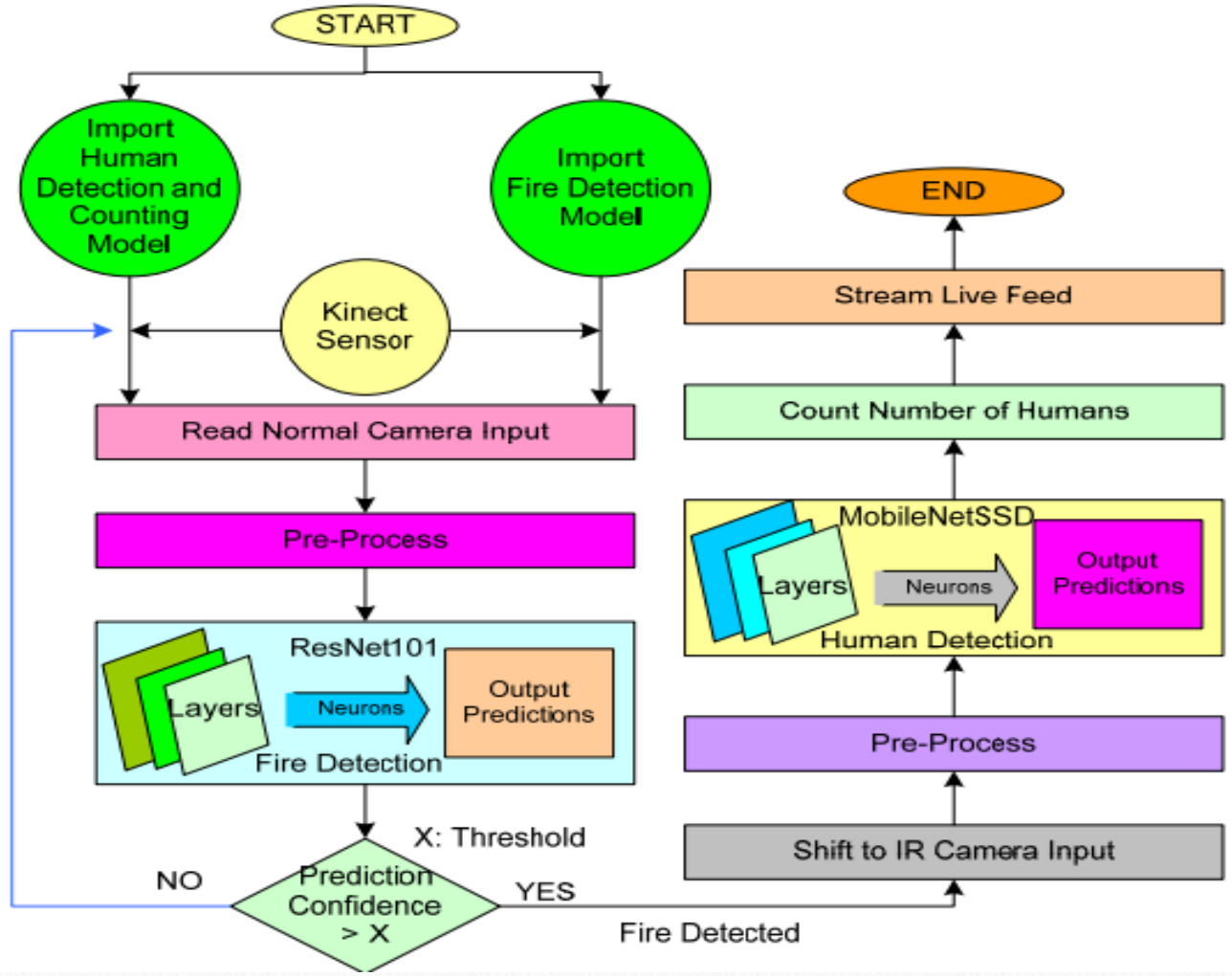
Counting of people

To get the estimated number of people in the building we will use the FOMO algorithm with the MobileNet SSD algorithm which allows us to calculate the number of people exiting the area through the exit. The number of people trapped can be found out by subtracting the people who enter the building by the people who are exiting the building

- ***Web Application***

It then streams the real-time output and the live feed to a network, which is then parsed by an application listening to the stream port. This feed can then be used by the concerned authorities to plan out further steps and evacuation procedures.

FLOWCHART O PROPOSED ARCHITECTUR



COMPONENTS AND BUDGET ESTIMATION

1) Raspberry Pi 4 Model B

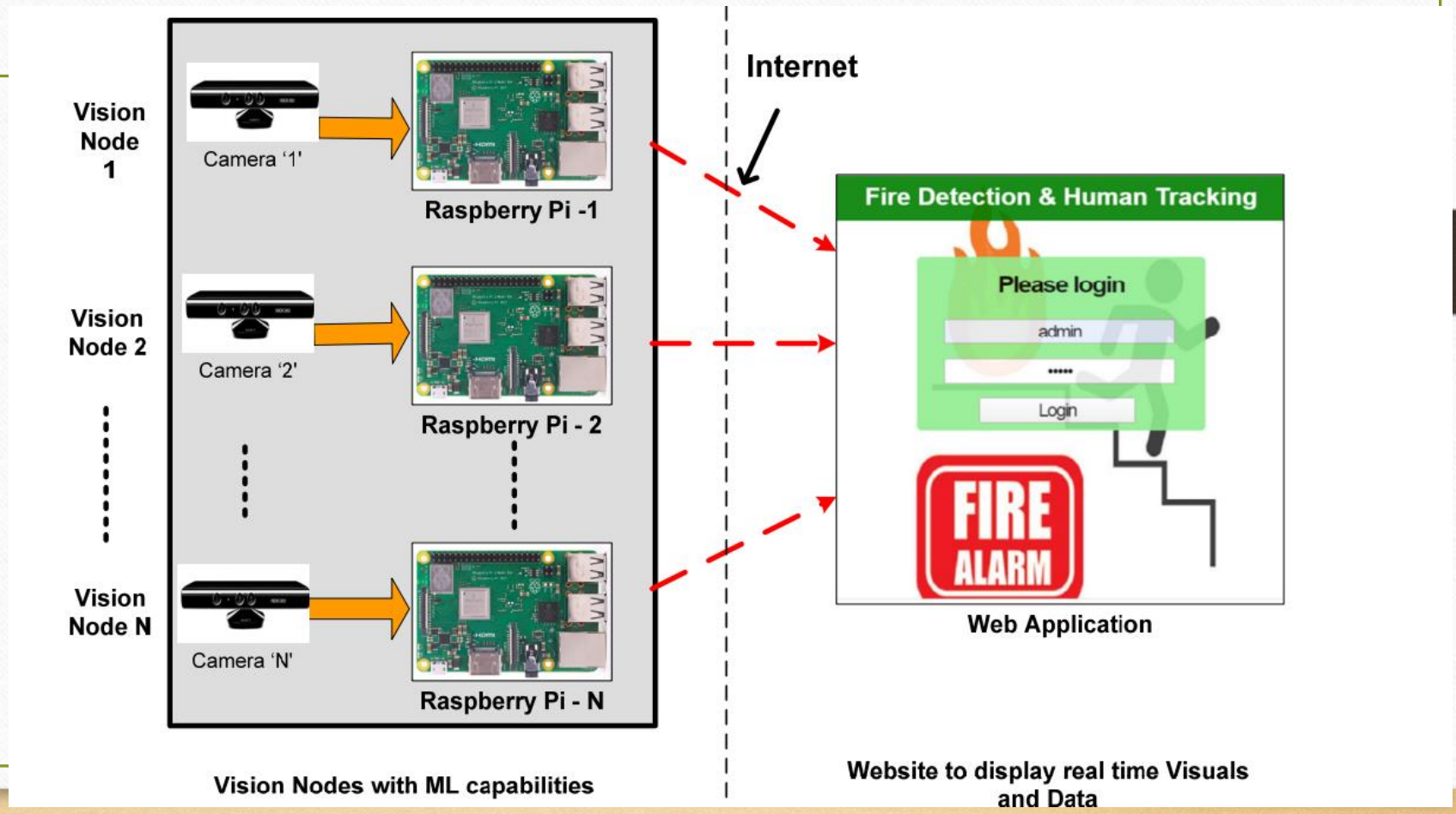
A series of single board computers

CPU: Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
RAM: 2GB, 4GB, or 8GB LPDDR4-3200 SDRAM (depending on model)
Networking: Gigabit Ethernet, 2.4GHz and 5GHz 802.11b/g/n/ac wireless, Bluetooth 5.0, BLE, Gigabit Ethernet, 2 USB 3.0 ports, 2 USB 2.0 ports, 2 micro-HDMI ports (up to 4kp60 supported), 3.5mm audio jack, and 40-pin GPIO header.
Storage: microSD card slot for loading operating system and data storage
Operating System: Supports multiple operating systems including Raspberry Pi OS, Ubuntu, and Windows 10 IoT Core.

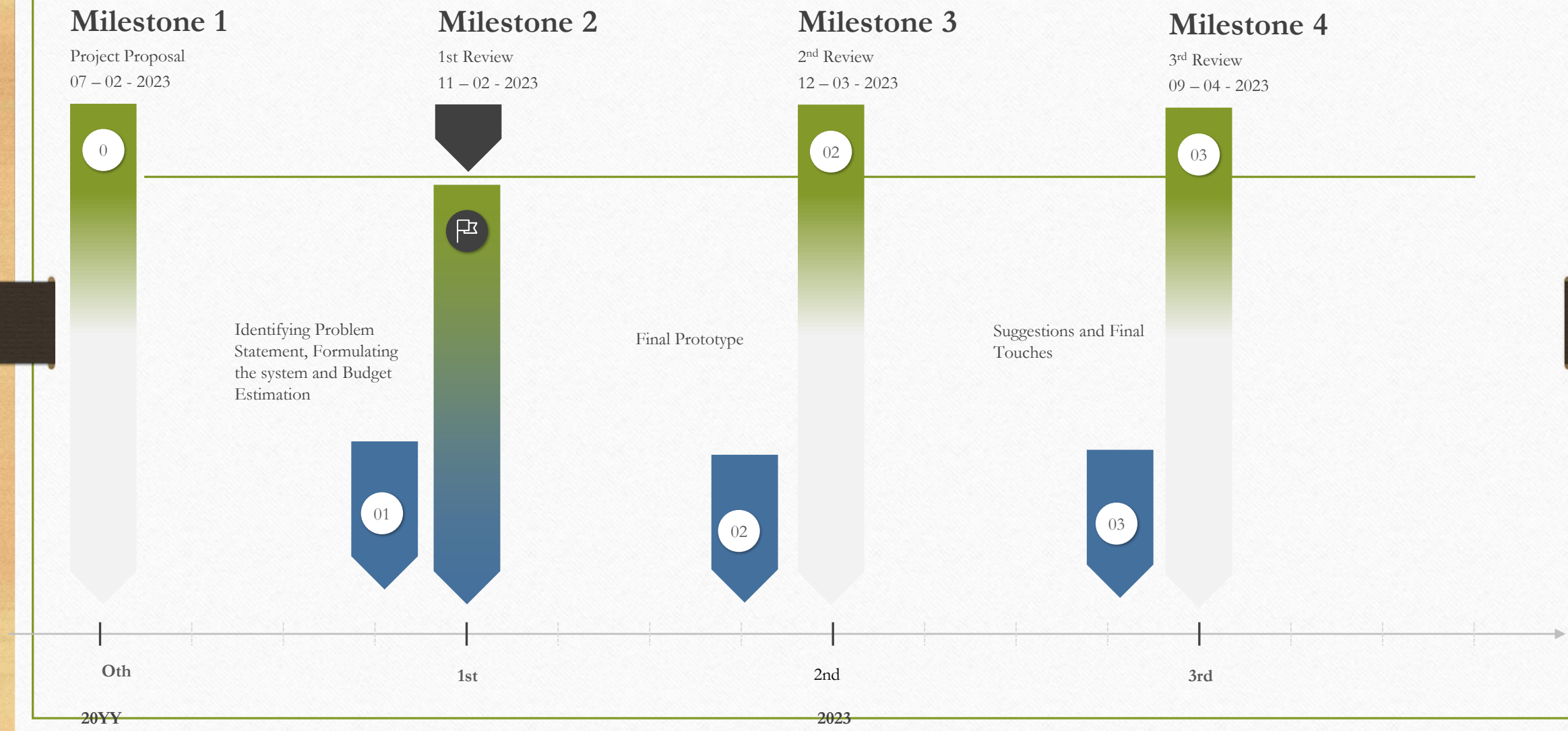
2) Kinect Sensor

The **Kinect sensor** is a motion-sensing device developed by Microsoft for the Xbox 360 and later for Windows-based computers. Here are the specifications for the original Xbox 360 version of the Kinect sensor:
Video camera: 640x480 pixel resolution, 30 frames per second
Depth sensor: 320x240 pixel resolution, 30 frames per second
Connectivity: USB 2.0

ARCHITECTURE OF THE SYSTEM



KEY MILESTONES



CONCLUSION

Fire detection and people estimation are very crucial during a fire accident. Early fire detection enables suggesting a safe exit path from the building for the people inside the building. Moreover, it is important to find the number of people stuck inside the building during a fire accident. Thus, in order to detect fires and to estimate the number of people in real time, we require a real-time visual capturing system. In this project, we have implemented a vision node based on Raspberry Pi with machine learning capabilities for detecting fire and estimating people count accurately in real time. Along with the vision node, we have designed a web interface that is capable of triggering all connected vision nodes by authorized signing in to the portal. Here, the vision node interfaces with the web portal through a local server hosted on Raspberry Pi. As the vision node is switched on, it starts capturing the real-time frame. Moreover, a machine learning-based pre-trained model processes real-time frames and sends the estimated result on web portals such as the status of fire detection and count of people

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