

Fungus Detection System

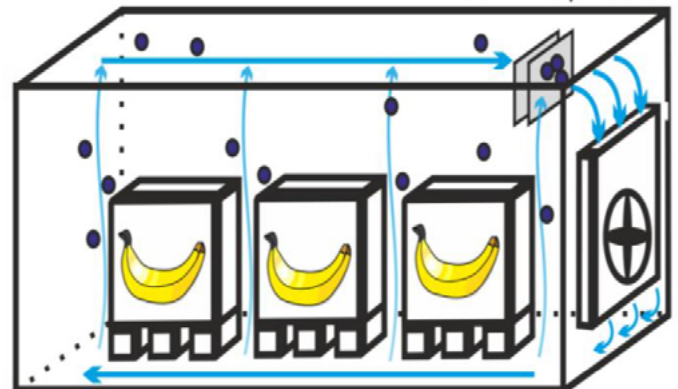
Fungus is an important part of a natural process. It is required for the decomposition of living things. So it is present everywhere even in your homes, offices, vehicles and in your surroundings. As a result of this process spores are released, which can enter into buildings with the help of air. Normally, you can see it growing on walls, woods, carpets, ceiling tiles, fabric etc. The main reason for fungus growth is moisture and temperature. In our buildings moisture is present in kitchens, refrigerators, showers, walls, wood etc.

Presence of fungus does not always mean it is dangerous for you and causes health problems. But when its growth increases and its concentration reaches up to ($>104\text{CFU}/\text{m}^3$) then it is a severe risk for human health. Mainly, it is a serious threat for humans with allergic and respiratory problems. It also causes fatigue, headache, cough, eye irritation etc.

Fungus in an Intelligent Container

The 'Intelligent Container' stands for new transportation systems with the capability to help determine, evaluate and to intrude during transports by pickup truck, rail, ship as well as plane. Temperature and humidity is monitored in it and then transmit the data to central control unit.

Fungus is not only a serious threat for human life but also to the food logistics. One third of the food produced worldwide is getting wasted. And the same amount of produced food does not arrive to the customer in an acceptable form. A large portion of this quantity is wasted due to improper transportation. Food starts its decomposing during the transportation and this decomposition is due to the attack of the fungus. We cannot control the fungus as it is present everywhere, even in food itself. But we can control the process of food decomposition by controlling the growth of the fungus. Its growth depends on temperature, air currents, humidity and lighting.



The fungus expands quickly in fruit having thin pores and skin similar to blueberries and strawberries as compared to fruit that is certainly firmer similar to the apple. The fungus can expand quicker therefore it may damage most fruits within the Intelligent container which will raise a question of the intelligence of Intelligent Container.

As stated earlier, Fungus can potentially cause many different damaging health and fitness consequences so; fruits having fungus shouldn't be consumed. If the fruit within the Intelligent Container got affected by the fungus then it is a huge risk for the health of consumers.

Problem Definition

Several techniques are used to reduce fungus threat but when we consider food in a large volume, containers of food, they miss the mark. Most of the techniques either require labor, time or costly equipment for the detection. For this reason, more reliable and convenient methods are required for the detection of the fungus. Until now, there exists no detection system which detects fungus and intimate timely. The Logistics industry needs such a system which automatically tracks fungus. Systems taking samples



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and giving detection result as output. The system will tell the user if a specific area of a container or building is affected from the fungus or not. Afterwards, appropriate actions can be taken and save the remaining container of food.

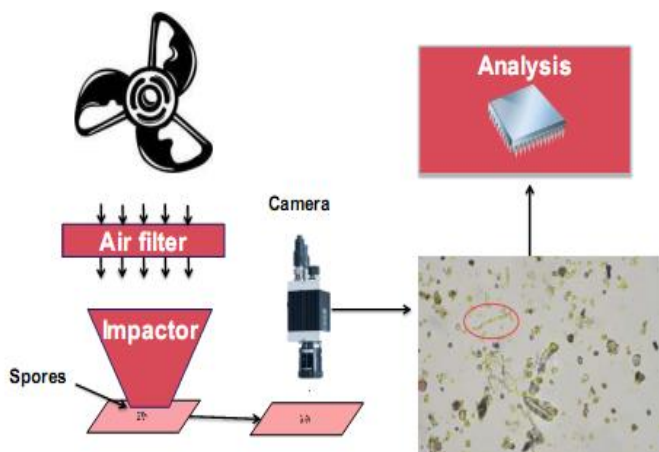
Proposed Approach

Simple, reliable, accurate and fast detection of fungus is required. For this purpose, recent researchers started using computer vision to detect microbial contamination in food products. Previously, researchers observed microbial elements through a microscope. We expect that the results are more reliable, precise and effective. But this becomes a hectic task when we talk about containers of food. When the volume is big then it is impossible to manage highly trained professionals to perform these tasks. In result of that we see inaccurate results. So the application of computer vision in this field is highly effective.

This system consists of main components like

- Microscopic camera
- Handling system
- Air sampling system.

An air sampling unit will be utilized to take air samples. This will collect air from its surroundings. With the help of an impactor we put this on a sampling tape. Then a handling system will move this tape under the microscopic camera. This will take the images of the air sample. These images are further analyzed through computer vision techniques.



First of all, images will be stored in the memory and then read in Matlab. For this project I will use Matlab and OpenCV as my image processing software. The fungus spores identification from the images will be performed through the following steps.

- Pre-processing
- Segmentation
- Feature Extraction
- Classification

In the first step, some pre-processing is required to enhance picture features and suppress noise. For this purpose, image is passed through some filters (Mean, Median Gaussian etc). Then, in the next step, segmentation is performed. In segmentation, there are two famous techniques (watershed and thresholding) for microscopic images. Both of them will be implemented and the results of these techniques will be compared. In the next step, features will be extracted from the segmented images. Color, shape and size will be used as features. Neighborhood is also a very interesting feature for the identification of different kind of spores. Finally, Support vector machines will be used as a classifier. Neural networks can also be used for the classification of particle as spore or dirt. Moreover, the rate of growth of fungus can also be interpreted and timely intimation about a fungus infection will be possible.

Outlook

The shortage of food increases awareness of losses, which demands sophisticated, reliable and cost effective methods to minimize the food loss. The analysis of large volumes using computer vision techniques minimizes the food losses in cost effective manner. Once the fungus is detected, we can take measures to control it and minimize food losses. Moreover, this system can also be used for the protection of archives.