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Swachh AI: Real-time Spitting Detection using Camera

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Abstract:-Today, all government authorities are fighting day and night against the spread of communicable diseases like the coronavirus. Therefore, the goal of the system is to focus on using the latest computer technologies to limit the spread of communicable diseases like the coronavirus by imposing a strict restriction on public sputum, using camera-based real-time surveillance systems, which are responsible for the maximum replication of the virus. To implement this system, the camera will capture the flow of images from public places and record the live activities of this area. This data will then be sent via the cloud and analyzed using the YOLOv5 model to detect public sputum. The results will be made available to local authorities using a web/mobile interface. Officials can then penalize the individual. Thus, this system will help public servants manage and monitor public sputum effectively.

1. INTRODUCTION

The greatest challenge facing humanity today is the COVID-19 pandemic. Human lives are at a standstill. Millions of people are affected around the world. Despite this scenario, some people still don't take it seriously and continue with their dirty habits that endanger the lives of others. One of these habits is public spitting.

In India, spitting is a common habit that leads to the spread of diseases like covid-19, colds, flu, tuberculosis, hepatitis, etc. Spitting in public is now an offence under the Disaster Management Act [1], but public spitting will increase once lockdown restrictions are eased and cause a maximum escalation in the number of COVID-19 cases in India. The proposed system uses the latest technologies to limit this irregularity in order to curb a pandemic

People spit water, saliva and items like tobacco in public places carelessly. Activities like these spread harmful germs and viruses in the surrounding area. The current system to solve this problem is completely manual and completely inefficient. Authorities must catch the culprits in crowded areas like train stations and bus stops. People tend to deny having paid a fine and quarrel with the authorities. Sometimes the authorities also tend to illegally fine innocent people.

To overcome the disadvantages of current processes, this system proposes to use CCTV surveillance systems in public spaces such as train stations, bus stations, etc. to track those who find themselves promoting such practices and simultaneously punish them so that such acts do not recur.

The document discusses the strengths and weaknesses of some existing practices in Section 2. Section 3 explains the proposed model and implementation is discussed in Section 4. Section 5 describes the results and conclusions drawn from the system.

2. LITERATURE SURVEY

Many recent techniques such as the Internet of Things, Cloud Computing, Big Data and Artificial Intelligence are capable of providing real-time crowd monitoring. Therefore, let's discuss a few survey-based systems

The system of Shubhi Jain et al. [1] focuses on the real-time detection of litter performed by passengers traveling in moving vehicles. It consists of three steps - the detection of the moving vehicle, the extraction of this frame and its analysis to detect garbage. But this system only works for garbage detection and not for sputum detection.

The system of Xiang Yao et al. [2] is an integration of data collected from multiple sensors to intelligently assess the cleanliness of roads. It is loaded onto a car to work and produce the required results. However, this system is not intended to punish individuals who are the cause of dirt roads.

In this system given by Wei Cui et al. [3], a sanitation vehicle captures the image of garbage lying on the road in real time. The YOLOv3-darknet model is used for garbage detection. But this technique cannot be generalized and is therefore specific to garbage detection only.

This article by Dan Zeng et al. [4] suggests a technique for monitoring garbage distribution in large areas. For waste detection, a multi-scale convolutional neural network is proposed. However, this method is not suitable for real-time detection.

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The article given by Chen Zhidong et al. [5] proposes a garbage sorting system based on high-order fusion. This method allows you to locate and identify small target objects in a complicated background, and then use a manipulator to automatically enter the sort objects. However, this system is not adapted to the problem of public spitting.

Jiale Xiong et al. describe [6] an anchor box and a yolov3-darknet model for identifying, classifying and detecting dry and wet waste. The results obtained show that this technique makes it possible to accurately and quickly identify dry and wet waste, to ensure the purity of wet waste above 90% and to meet the requirements of secondary waste treatment. However, this technique is only suitable for passive garbage detection.

Shih-Hsiung Lee et al. [7], proposes a model of light deep learning. The basic network architecture of Single Shot MultiBox Detector is replaced by Alex Net. Thus, the model settings are significantly reduced without affecting the object detection capability of the SSD. The results make it possible
to accurately recognize the types of waste. But this system is not useful for identifying the person who threw away the garbage.

S. Sarath Chandra et al. [8] use the Internet of Things (IoT) to monitor garbage. Here, a bin is intelligently built with a microcontroller with sensors. It works using the AND operation. Yet this method is only focused on monitoring and not on garbage detection.

Ying Wang and Xu Zhang [9], use a machine learning technique for automatic garbage detection. The results obtained show that the method has a high-precision detection function and a good generalization capability. But this method cannot be used for the real-time detection feature.

Siddhant Bansal et al. [10] act as a human to pick up garbage. It has the ability to detect garbage in real time with 90% confidence. But, it is not practical to identify the person responsible for the dumping of garbage

The application given by Gaurav Mittal et al. [11] uses convolutional networks for the detection of garbage in images. It also suggests improvements in network architecture that result in reduced memory usage and prediction time without loss of accuracy. However, it is useful for near real-time detection only

From the above literature, it is clear that most of the work is done for garbage detection and there is no standard structured procedure for detecting sputum in public places. The proposed system uses IoT, Deep Learning and YOLOv5 for the detection of sputum in public places.

3. PROPOSED MODEL

Fig. 1 below shows the architectural design of the proposed system. The parts of the proposed system are described as follows:

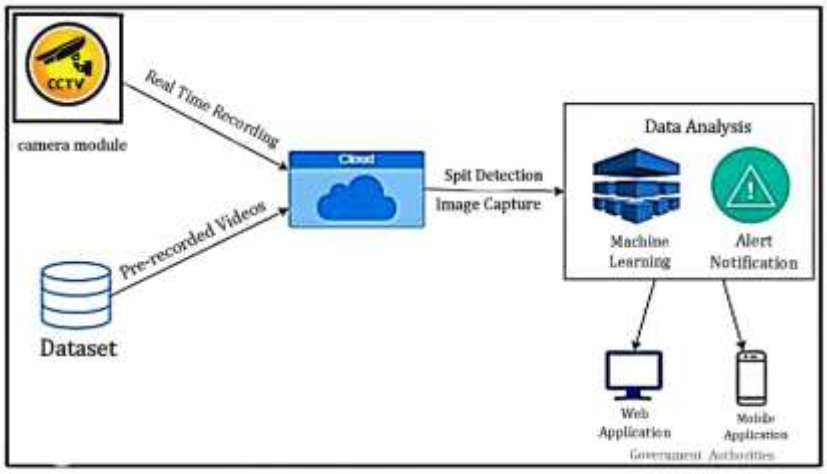

Fig. 1 - System architecture

Camera Module: Camera offers a platform for smooth communication and allows information sharing between platforms in a favorable way. This module should be used with the Raspberry Pi camera module, as shown in Fig 2, with a size of about 25 X 24 X 9 mm and a fixed resolution of 5 megapixels to capture images and videos in real time

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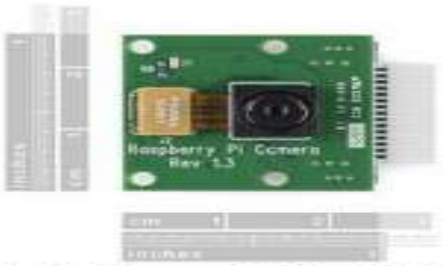

Fig. 2- Camera Module [13]

Dataset: This module consists of pre-recorded videos of public places such as train stations, bus stops, shopping malls, etc., which will be useful for training the real-time analysis system

Cloud Analytics: It's a logical server. Thing Speak is a powerful cloud server that performs application storage and information processing. It has additional advantages over a regular cloud service. It can be accessed remotely from a service provider.

Data Analysis Module: Data Analysis Module Analyzes sputum points and generates alerts. As shown in Figure 3, the system will be tested using the You Only Look Once (YOLO) model. It will then be assessed using performance measures such as accuracy, precision, recall and F1 score. Therefore, it is planned to test the system on different algorithms. In addition, more and more data would be collected by the system, which could also be used to improve the accuracy of the system.

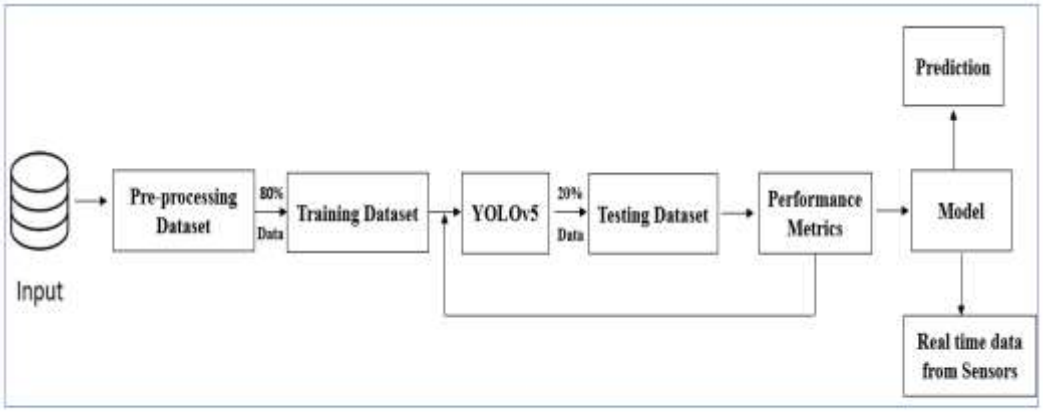

Fig.3-Analysis System

Web and mobile application: It will receive the images of the culprits through the cloud server. The images will be saved on the cloud server and can be used for future analysis. The data of the culprits, including his personal data, would be taken through the application.

4. IMPLEMENTATION

To design the proposed system, the data collected consisted of 200 images. As shown in Figure 4, this data was collected over the Internet using techniques such as web scraping and data mining. This data was combined with real-time video to detect public spitting. This data contained images of people spitting and others not spitting in order to achieve high accuracy after applying machine learning algorithms.

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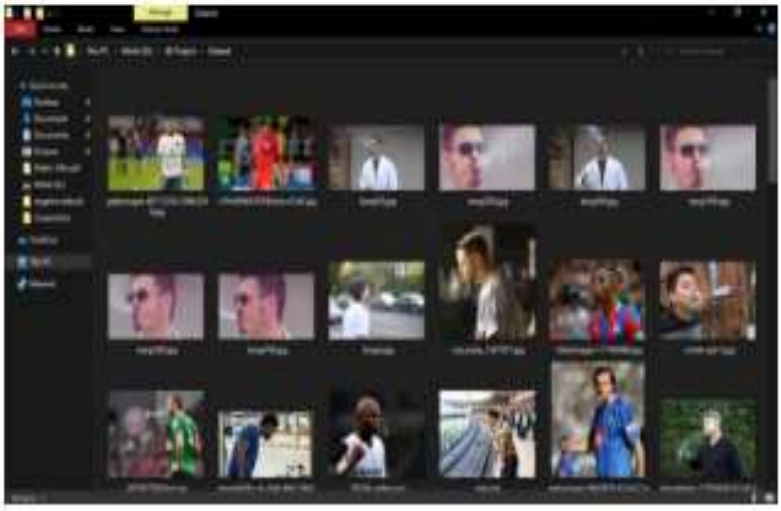

Fig. 4 - Images Collected

The next step is to label the collected images using labelling. As shown in Figure 5, this is a tool for annotating a graphic image. For its graphical interface, it uses Qt and is written in Python.

Fig. 5 - labelImg

The collected data was then pre-processed because the images had varying sizes and resolutions. The goal was to provide uniformly sized data to the YOLOv5 algorithm for training and testing purposes.

5. RESULT AND ANALYSIS

Using the modules mentioned above, the camera module first retrieves real-time video and image data from public spaces. The image is sent via the cloud server to detect public sputum using artificial intelligence methodologies and the results are eventually displayed on the local authorities' web and mobile app. Officials can then penalize those guilty of public spitting.

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Fig. 6 - Person detected spitting

Fig 6 given above shows that an image with a person spitting is correctly identified by our system with an accuracy of 94% and Fig 7 given below show that an image with a person who is not spitting is correctly identified by our system with an accuracy of 85%.

Fig. 7 - Person detected not-spitting

6. CONCLUSION

Covid-19 is a pandemic that, so far, has claimed the lives of an estimated 1,49,886 people in India and 1.86 million people worldwide. This number will continue to increase until the chain is broken by inhibiting the spread of the virus.
Therefore, the system uses many recent techniques such as the Internet of Things, Cloud Computing, Big Data and Artificial Intelligence, capable of monitoring public spaces and giving timely and predictive alerts to local authorities in case a person is found spitting. This will reduce public waste, making the environment cleaner and healthier.

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