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CHAPTER 7

Smart equipment to protect patients and people from COVID disease

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7.1 Introduction

With the emergence of the great disastrous pandemic, COVID-19 has become an alarming threat for each and every individual on the planet. The meaning of the phrase “survival of the fittest” is scientifically proven nowadays. Although there are many steps taken to cure covid spread, the disease not only affects the medical care it affects all the environment in the society. The present hospitals - government hospitals, private hospitals, villas, modern hotels, railway compartments, auditoriums, malls, halls etc. all places are affected by virus (World Health Organization, 2020c). To reduce this virus sanitation and hygiene are the only way to reduce the disease spread. The whole world moves toward reduction of death rates due to virus spread in different countries, while the different countries works on reducing virus spread to cure the patients and in the other side normal people should pick their work in a fine and effective way. The triggering question is “Are the health care wastes disposed properly? Or reiterates to evolve further other infectious diseases?” The hospital environment should be kept clean and hygienic. To do so, human resources should be reduced. When the containment dustbin is left unemptied for hours or left untreated with medicare wastes, the oozing smell, infectious and hazardous wastes end up in becoming a still more greater threat to humans. If 10% of the workers in hospital pass by this hazardous waste frequently, 75%—80% will get infected with the virus. More number of patients are isolated in each ward, 50% of people may get infected. So, in order to get rid of this infection the safeguard metrics and measure should be taken to reduce the risk. The disposal of these infectious wastes must be done in a more planned and trouble-free manner to reduce the harm and societal impact (World Health Organization et al., 2009). The solution to this problem will be a benefit for other reusable resources and it will reduce 80% of the challenges faced by the curative effects of COVID-19.

The COVID-19 pandemic period started with an initial stage with minimal effect. The situation changed and gradually the virus spread throughout India. At each stage the death rate increased gradually and people were affected by virus. The proposed method deals with a solid waste management system where unwanted wastes were cleaned then
and there. All the wastes are cleaned by human power. To reduce the manpower required an automated disposal IOT-based robot has been designed to care for the people affected by virus. Here all the waste used by a COVID patient is disposed of by the robots which helps to reducing the required manpower and also protects other persons in the hospital environment. When the doctors treat those people who are affected they dispose of the waste separately (World Health Organization (WHO), 2014). When these disposable materials are taken by an automated robot it can prevent the spreading of the virus.

Each day the medical equipment can also be supplied by the model which can be designed to reduces much human manpower, even the nurses who carry the medicine can also be supplied by this robot. The automated robot lifts all heavy waste and medical equipment and also supplies food to the virus-affected people. This enables the efficient supply of all equipment. The robot is fully sanitized so that it will not cause any problems to other people in the hospital.

### 7.1.1 Background

The technology used here is an IOT-based sensing device which is automated using an application which controls the entire system to reduce the human manpower. The control system can also monitor doctors’ moves and can alert both doctors and the waste management system to keep the environment clean (World Health Organization (WHO), 2020b). The automation reduces human power to remove the waste, it will lead to have a better and unaffected virus infection environment. The equipment is disposed of in an efficient way. The end user can gain an automated system which reduces human manpower and machines can treat humans in a safer way. The innovative idea here is to monitor the waste and also the doctors movements. The main motive here is to reduce the danger of the virus to humans. The model is designed in a cost-efficient way. The method used to solve the problem is that wastes are collected and segregated and then converted into biodegradable waste. The process of conversion includes simple methods where a closed chamber is designed and all the waste is treated under heat and pressure to crush the waste into smaller particles and converted into reusable waste. For each 20% of waste the solution can give 15% of reusable materials for the beneficiaries. So it can produce up to 85% of reusable materials where the ratio is more (World Health Organization, 2020a). Here a machine learning technique is used to produce an effective biodegradable waste. The usability is high when compared with other systems.

The different target beneficiaries are waste management and the hospital maintenance team. Here we mainly target the hospital maintenance team because to reduce the human manpower we collect all the waste and make those waste into biodegradable waste. In the current market all the smart dustbin are made with sensors which leads to more cost for implementation (Michigan Occupational Safety & Health, 2017). Keeping this in mind we produce a cost-efficient model and finally use the reusable waste in the agricultural field. The low-cost system is developed both for the hospital and also for the
agricultural field; the farmers are struggling to produce good quality reusable waste to improve crop yield on their farms. The hospital maintenance can also benefit by reducing the manpower required and removing people from contact with the hazardous wastes.

7.2 A review on waste management

To begin, ensure you remove all jewelry and personal items and that your hair is tied back if applicable. Make sure you consider the risk involved in the care you are going to provide to the patient to ensure you are using the appropriate PPE for the precautions needed. Step one is to perform hand hygiene. You can clean your hands by rubbing them with an alcohol-based solution. It is the fastest and most effective method and better tolerated by your skin than other methods. Follow the WHO technique that ensures all the surfaces of the hands are carefully covered by the product and will eliminate the microorganisms on your hands. Follow the following steps: apply the product into a cupped hand. Next, rub the hands together, rubbing palm to palm. Rub the back of each hand with interlaced fingers. And then palm to palm with interlaced fingers. Next, rotate the hands in a cupped shape. And then rub your hands rotationally. The final step is to rub the tips of your fingers and nail beds in each palm and continue rubbing until hands are completely dry. Congratulations. Now your hands are clean and safe to proceed with the PPE.

The underlying driver is COVID 19 and to decrease demise rate, hospital climate ought to be kept spotless and sterile to do so human asset can’t be utilized for cleaning measure. Patients in the clinic are given therapy, utilized drugs and one time clinical gear ought to be arranged appropriately sweepers are focused here. In the event that guess 10% of the specialists in medical clinic are sweepers there is a chance of half different people can influence, there is a circumstances and logical results measure which builds the proportion here is 1:5 (CDC. Centre for Disease Control and Prevention, 2017). The current arrangements proportion is too high in present situation when contrasted and history of information bases.

The value proposition in this problem is making the waste into biodegradable waste. The different adoption barriers the solution overcomes are maintenance can be reduced and risk factors are reduced for human resources (Atkinson et al., 2009). The monitoring device is easy to use and consumes less time for proving notification. The manpower is reduced for the disposal process and many barriers can be overcome by this solution obtained. The biodegradable waste can be utilized for many purposes. The customer can validate this process by demonstrating the novel approach used in this model (Tseng & Li, 2005). A survey can be used to validate the solution and the target beneficiaries can also act accordingly. The experimental logic will help customers to validate the challenges. In today’s scenario validation is much easier for tracking the challenges faced by the human. To validate the process the time required for the process will be too low.

Fig. 7.1 explains how the waste is collected, checked, and classified, and how all the segregated wastes with nonhazardous objects are identified with many forms.
At each phase humans are getting affected from the solid waste used by the affected person. This method is a more improvised way of developing the system for removing unwanted waste from nonhazardous objects.

7.2.1 Working model of disposal of waste using smart equipment

In this section the waste removal is made by the IOT-based smart robot. Here a multipurpose model is generated where it is not only used for disposal waste it is also used for carrying the medicines to the patients and also for serving foods to each person (Kowalski, 2009). The entire process is measured and equipped with good working condition. Here there are many multiple uses carried out to achieve a better result.

Fig. 7.2 shows the different parts available in the working model where the components are attached to a motor wheel for making a smooth movement from one place to another. In the given figure component one defines a steel plate which carries waste with lots of weight and a sensor is placed on the plate acts as calculating equipment which finds the total weight and by the eye ball it can scan object inside, when it lifts the waste (Welch et al., 2018). Finally it gives the result by classifying how many chemicals are present and how many fertilized objects are present. There are three main
components available in which object 1 is used to lift the waste. Object 2 is used to carry materials like water bottle, sanitizer, facemask, etc., and finally object 3 is used to balance the food materials and also the waste box.

Fig. 7.3 describes the movement made by the robotic object to find the waste bin. The notification is sent to the robot after the bin is filled with waste (Awbi, 2016). The sensor is placed and an application is designed to send and receive the signals from each place around the hospital. After finding the waste bin it is lifted and moved to the recycling process where the classification is made on nonhazardous waste.

Fig. 7.4 explains the movement of the robot, in which the waste bin is moves to the complex where the biomedical waste is disposed of in to recycling process.
plates here are used to lift the waste bin adjustments can also be made in the plate. This is the one which is been available in and around the hospital environment. The processes are evaluated through the system which calculates the weight of each hazardous waste. Also reusable waste is identified by an eyeball which is used to sense the

**Figure 7.4** The moving robotics for disposing the waste into the biomedical complex.

**Figure 7.5** The working model of the waste system disposal.
object, which is also being scanned in parallel. The data are entirely analyzed using the a priori algorithm which helps to identify the different objects present inside the waste bin (Fig. 7.5).

7.2.2 Case study on COVID-19 sample data to identify the percentage of data analysis

Fig. 7.6 shows the flow of working model.

7.2.3 Analysis made of the waste disposal

There are separate processes for normal waste disposal and for the COVID waste disposal process (Fig. 7.7). Fig. 7.8 shows how a COVID-affected area is cleaned and how the disposal process is carried out in the minimum time (Figs. 7.9–7.11).

The total weight estimation is calculated when the waste bin is filled and notification is sent through the smart robot, which will come exactly to the place where waste

![Figure 7.6 The flow of the working model.](image)
Figure 7.7 Three main phases of disposal process.

Waste taken from the Covid affected area

Airtight container

Burn the waste

Figure 7.8 COVID-affected area and its disposal process.

Figure 7.9 City-based estimation on waste management.
bins are placed in the hospital environment. When the robot collects the waste bin it will start to evaluate its weight and also will scan the waste inside the waste bin. The data set is taken and is evaluated with the weight. The feature selection process is
carried out for the future classification done on the dataset. Each attribute in the dataset is selected for identifying nonhazardous waste and hazardous waste, reusable waste and nonreusable waste. All these wastes are transferred to the biomedical center, and food waste which is disposed of by the patient is also recycled for use in fertilizer. The robot collects the data from the sensor and calculates all the detailed information dynamically and it is being stored in the data set. Those data sets are used to analyze this kind of feature selection process and for the classification process. This process is looped to recycle the entire waste, and each process is frequently estimated through weight (Fig. 7.12).

Fig. 7.13 shows input data collected from the sensors of both the plate and the eyeball that scans the objects from waste bin (Eickmann et al., 2020). This helps in identifying the objects and classifying them into different forms such as reusable object or hazardous or nonreusable waste. The classification is done on all the data that is analyzed by the sensor and each input helps to identify the data. Whenever the destination gets filled the notification is sent to the robots which start analyzing which basket is being filled and it is their duty to take that particular bin alone to the waste complex of the biomedical center.

In Fig. 7.14 analysis is made on the data set to identify the average people who have been affected with COVID-19. A survival analysis has been made on the whole data set with frequent iteration. The classification is made on both females and males, children and adults who have been affected with COVID-19, as well as the result is

![Histogram of v](image)

**Figure 7.12** Weight estimation process.
been executed through the classification algorithm, in which the value $P$ is being evaluated with waste bin weight estimation. The information is retrieved from the data set in the current situation of the entire data. This result will identify each individual person’s health and show whether it has been affected majorly or not with a result of either yes or no. Different classes are made based upon the frequent iterations, i.e., class 1, class 2, class 3, and so on, in which the age factor is characterized and it is classified to get the exact result.

**Figure 7.13** Process of recycle process of the waste segregation.

**Figure 7.14** Analysis made on the dataset to identify average people affected in an age-wise survey.
7.3 Conclusion

The different target beneficiaries of this model are waste management and hospital maintenance teams. Here we mainly target the hospital maintenance team because it reduces manpower requirements and collects all the waste and turns the waste into biodegradable waste. In the current market all the smart waste bins are made with sensors which leads to more cost for implementation. Keeping this in mind we have produced a cost-efficient model, with the final use of reusable waste in agricultural field. The equipment is disposed of in an efficient way. The low-cost system has been developed both for hospitals and also for the agricultural field. The hospital maintenance can also benefit by reducing the manpower and the removal of hazardous wastes. In all medical fields and hospitals this method can be implemented.

7.4 Future work

In the future the work can be enhanced by implementing it for the whole recycling process in the solid waste management system. It can be used for the entire environment, not only in the medical field. The work can be an extension to which new features can be added for improving the efficiency and it also removes the workload for all humans. This will give more benefits to society in this pandemic situation and also in the postpandemic phase across the country.

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