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Plate Dispenser Using Face Recognition to Prevent Food Wastage in Hostel Mess

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Abstract

Food wastage in hostel mess facilities is a persistent and critical issue faced by educational institutions, primarily due to unauthorized access by day scholars and repeated food collection by the same individuals. Conventional food distribution systems rely heavily on manual supervision, identity cards, or verbal verification, all of which are inefficient, error-prone, and susceptible to misuse. This paper proposes a fully automated plate dispensing system based on face recognition technology to ensure controlled and fair food distribution in hostel mess environments. The proposed system integrates computer vision techniques with embedded hardware components such as a Raspberry Pi, Arduino microcontroller, relay module, and solenoid lock to automate the entire plate allocation process. Real-time facial images are captured through a camera and processed using OpenCV-based face detection algorithms. The detected face is verified against a pre-trained dataset consisting of hostel students and non-hostelers. Only authorized hostel members are allowed to receive a plate, and the system ensures that each individual is served only once per meal cycle. A dataset of 800 individuals is used for training and validation, with live image capture during testing. Experimental observations demonstrate that the proposed system effectively reduces food wastage, prevents unauthorized access, and improves transparency, accountability, and operational efficiency in hostel mess management. The system provides a scalable and cost-effective solution that can be further enhanced using cloud integration and mobile-based monitoring.

Keywords: Face Recognition, Automated Plate Dispenser, Hostel Mess Automation, Food Wastage Prevention, Computer Vision, Embedded Systems, Raspberry Pi, Arduino.

1. Introduction

Managing the mess in a hostel is a difficult operational task for schools because there are so many students, not enough resources to keep an eye on them, and no automated verification systems. Unauthorized access by day scholars and repeated food collection by people who take advantage of manual distribution processes are two of the main reasons why food is wasted in hostel messes. People have to keep an eye on traditional systems, which costs more money and can lead to mistakes, inconsistencies, and abuse. This means that schools lose money, don't plan their meals well, and are less responsible. Thanks to better biometric technologies and embedded systems, automation has become a useful way to solve these problems. One of the many ways to authenticate someone is by recognizing their facial features. It doesn't bother you, doesn't require contact, and is simple to use. Face recognition doesn't need you to touch anything or use extra tools like RFID cards or fingerprint scanners. It's excellent over establishments that serve meals efficiently and thoroughly. This piece of work discusses. The way to set up a computer-controlled dish serving system which employs identification of faces to guarantee that only pupils and teachers whose have the right to get nourishment can do so. Every day, students have been forbidden consume food at all. The procedure also has logic in it to help make sure that every person gets a duplicate plate. This helps to make certain that every person gets enough of everything and that food does not go bad. The idea uses vision-based procedures and hardware-integrated programming to make hostel mess automated simpler, less costly, as well as simpler to grow.

2. Literature Review

A lot of analysis has been done on electronic management and authentication control in distribution systems that use different kinds of ID technology. Many people use RFID-based monitoring devices because they are inexpensive and straightforward to use. However, they also happen to be easy to distribute, lose, and duplicate. Fingerprint-based biometric authentication systems have safer, but they require interaction with people, which raises questions about sanitation while rendering them less inclined to be deployed in food preparation areas. People need to work together to use QR code systems[17], and it's easy to copy or misuse them. Face recognition [18]is now a safe and reliable choice because it doesn't need to touch anything and can process data in the moment. Researchers have shown that Haar Cascade classifiers that use OpenCV work well for finding faces in systems that are used for attendance tracking, surveillance, and access control[5]. People like Raspberry Pi and other embedded platforms because they are cheap, small, and powerful enough to process images in real time[8]. Prior research has underscored the benefits of integrating computer visionwith IoT and embedded systems for automation[16]. Nonetheless, there has been insufficient research on the amalgamation of facial recognition technology with mechanical food serving systems in hostel mess settings[1]. This paper builds on earlier work by combining real-time facial recognition, eligibility verification, and computerized plate dispensing into a single system that is designed to reduce food waste and keep people who shouldn't be there out of hostel mess facilities. How the System Works.

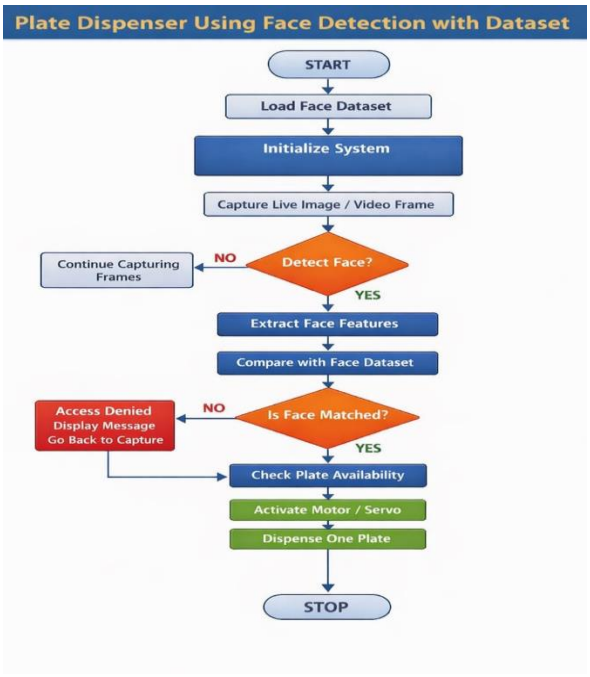

Figure 1.

The overall layout of the face recognition plate dispensing system. demonstrates how the control unit, vision module, and mechanical dispensing device all work together.

It shows how data goes from getting a picture of a face to automatically giving out plates by coordinating the control of the built-in hardware. The system in question architecture is a modular and expandable framework that has three main components: the vision-based recognizing subsystem that comprises the decision-making and control sub system, and the mechanical drug dispensing subsystem of the system[17]. A camera is always filming people as they walk up to the food distribution counter. The Raspberry Pi gets these frames and does something with them. Running algorithms to find faces and make choices. The Haar Cascade classifier from OpenCV is used by the face recognition subsystem to find facial features[4] in each video frame in real time[3]. The system compares the person's face to the stored dataset to see if they are an authorized hostel student or an unauthorized non-hosteler. Based on this check, the Raspberry Pi sends a control signal to the Arduino microcontroller through serial communication. The relay module is controlled by the Arduino, which turns on the solenoid lock[11] that releases the plate[7]. During successful or limited operations, a buzzer makes a sound to let you know. The modular design makes sure that each subsystem works on its own while still being able to talk to each other, which makes the system more reliable, easier to

maintain, and easier to grow. A block diagram and flowchart show the whole system architecture clearly.

3. Methodology

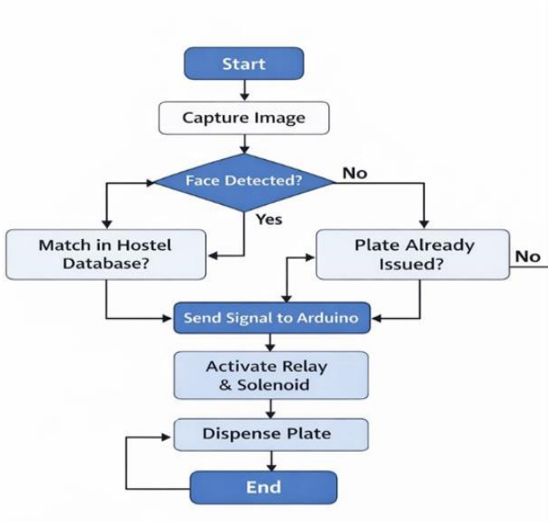

Figure 2.

diagram demonstrates the way identifying faces, verification assessment, replica plate elimination, and relay-governed valve operation all work in order.

The suggested face recognizing plate distribution technique implements a scheduled, ordered, and planned approach to ensure sure that it functions right, reliably, as well as real time. The initial step is to get information. This is done by using the camera located at the boarding mess entryway to take immediate photographs of people's faces. There are 800 pictures depicting individuals in the set of images, 450 of whom are students living in student apartments while 350 of whom are not. These pictures were taken within regular conditions and retained in colour so that the faces' distinct characteristics and details would stay. The camera continues to capture current video images [9] even when the computer system is operating. The device known as the Raspberry Pi then gets the frames in order to process them. a process including trimming and reducing noise, is done to each photograph to make finding better. The Cascade of Haar classification algorithm is subsequently utilized for identifying faces given that it is quick and functions well on small devices[8]. The software examines to see if an individual is permitted to stay there by juxtaposing the face it sees against the maintained file[6]A logical decision-making system is used to find out if the person who was detected is a hostel student and if a plate has already been given out during the current serving cycle. When the same person stays in the camera's field of view, a control flag mechanism stops the triggering from happening again. After the verification is successful, a serial command is sent to the Arduino microcontroller to start dispensing plates[14]. The system blocks access if the person is not authorized or has already been served. The method makes sure that food is distributed safely, fairly, and automatically, with as little help from people as possible[17].

4. Hardware and Software Implementation

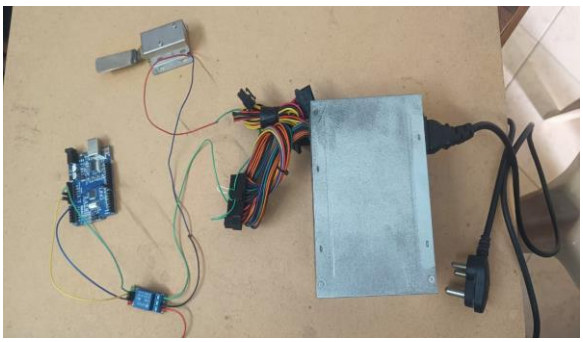

Figure 3.

Hardware implementation of the proposed system consisting of Raspberry Pi, Arduino, relay module, and solenoid lock. Shows the practical hardware setup used for real-time testing and deployment[8]. It shows how processing units, control modules, and mechanical actuators are physically connected.

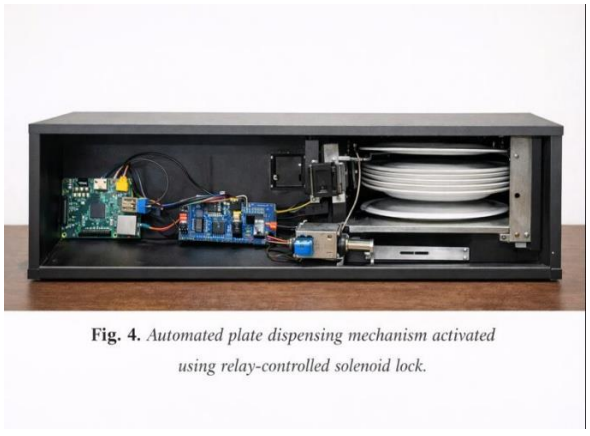

Figure 4.

Automated plate dispensing mechanism activated using relay-controlled solenoid lock. Shows the relay-equipped solenoid actuation mechanism that controls the dispensing of plates.

It shows how the system works physically after a successful face verification. The computer software and hardware implementation of the system that is suggested has been meticulously crafted to ensure flawless integration between real-time identification of faces and mechanical plate dispensing[20]. The

Raspberry Pi is the main processing unit. It captures video input, runs face detection algorithms, checks the validity of datasets, and sends control signals. [8]The Raspberry Pi connects to a USB camera so that there is always a live video feed on the dispensing counter[8].The microcontroller known as Arduino is used to control hardware parts in a way that is reliable and predictable. Using UART connections at a rate known as baud of 9600, the Arduino and the Raspberry Pi can talk to each other in a serial way, which keeps them in sync[7]. When it gets control commands, the programmed Arduino turns on the relay module, and it regulates the 12V motorized lock that opens the plate[14]. A buzzer is built in so that you can hear when the dispensing is successful or when access is limited. From a software point of view, the programming language Python is used for developing the code for face detection[12] and making decisions because it is flexible and has a lot of libraries. For real-time face detection, the OpenCV library has fast computer vision functions that are needed[13]. You can use Embedded C to program the Arduino to control electrical relays and keep track of time[14]. This split of duties between hardware and software makes the system more stable, reduces down on processing overhead, and makes sure that it responds in real time[6].

5. Results and Evaluation

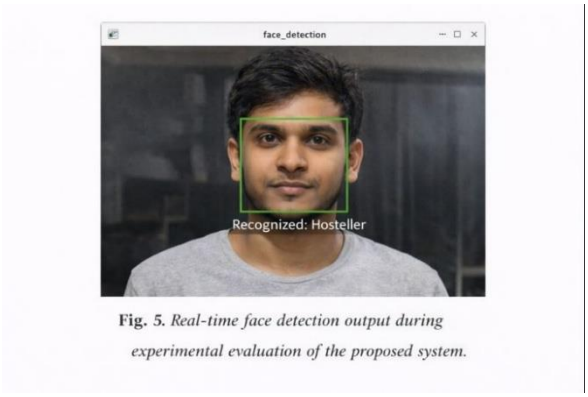

Fig. 5. *Real-time face detection output during experimental evaluation of the proposed system.*

Figure 5. Real-time face detection output during experimental evaluation of the proposed system.

Figure 5 showed an example of how the system could find faces in real time while it was being tested[7]. It shows how the system found the box around people who could use the plate before it was given out. We tested the suggested plate dispenser system that uses face recognition in a controlled hostel mess-like setting to see if it worked, was useful, and could be used in real life[17]. During the evaluation phase, a test dataset with 100 pictures of students living in hostels and 100 pictures of students not living in hostels was used. The camera module took pictures of real people's faces, which meant that the system was tested in real-world situations instead of with static or offline inputs. The technology was able to observe individuals in real time and could tell who was intended to be there currently based on whether or not their bodies were allowed to be there throughout each assessment cycle. The system made absolutely certain that only pupils that were given permission to eat in the hostel could get a plate, and that each person could only get one plate at a time. The software's logical control system worked well to make sure that the same person did not get more than one drink, even if they were in front of the camera for a long time[6]. People who were not supposed to be there or who were not staying in a hostel were always told to leave. This kept people from using resources in the wrong way. The computer's Raspberry Pi-based identification software and the power sourceArduino-governed[15] dispensing machine[16] collaborated well when combined[6]. There was just a tiny delay between the when the face detection occurred and when the necessary action was taken. We did not explicitly estimate out things like response timing and precision proportion, nevertheless we did qualitative evaluations that confirmed that the system performed the same way each and every time, could reliably determine faces, as well as make the right choices. The outcomes show that the proposed system can help reduce food waste, stop residents from eating what they shouldn't, and facilitate the institution's cleaning operations more open. It demonstrates why it is an adequate alternative for use in real life.

6. Limitations

They made the solution that was suggested and tried it out. It worked, nonetheless there nonetheless remain some things that still have to be fixed. Because you use tiny gadgets like the Raspberry Pi, it takes much longer to find individuals in real time, which is the biggest problem[8]. The Haar Cascade[1] visual classifier is quick, but it tends to slow downward when it needs to work with footage streams that have a greater resolution and need greater processing capacity[5]. The technology is able to observe one person's face at one point in time. If there are multiple individuals who are in front of a camera, it could mean being able to see them immediately or put them alongside the right group. It may additionally have trouble determining faces if there is not enough illumination, if there are shadows

around them or if the camera is not in the right place. If someone has facial hair, wears accessories, or gets older, it could become harder to tell who they are. The system additionally demands an information set that is already there. We need to add novel individuals who are interested to stay in a bed and breakfast to this dataset every so often. To fix these problems, we must utilize better hardware, more sophisticated comprehension models, and improved techniques to control the external environment.

7. Future Work

The recommended platter distribution arrangement represents a good first step toward attempting to make easier to run hostel messes. But there are several ways for making it work better, prove more beneficial and be considered easier to use. In the near future, it will be necessary for connecting the infrastructure to an application for mobile devices that helps mess administrators change the configuration, keep track about distributed food details, and manage user permissions from a distance. This type of app can assist managers stay organized and make decisions quickly. It is a big improvement that you can now store all of you are facial information, accessibility logs, and movement documents in one cloud-based database. Integrating with the cloud would allow it easier to reach a lot of schools since this would let a lot of messy establishments connect with a single system. You can also make screens that display graphs of data, everyday usage visualizations, and alerts for variations that are helpful that do not make sense. When it applies to advances in technology, moving from traditional Haar Cascade® classifiers to sophisticated learning-based identification of faces models can render the models substantially more exact, faster, and robust in various kinds of light. introducing additional video cameras and upgrading the computer equipment can speed things up even more and let a few people work at the same time. The system that was suggested would be a complete, intelligent, and adaptable way for clearing up messes if these changes were made.

8. Conclusion

The current research introduces an innovative and thorough face recognition-driven computerized plate dispenser aimed at mitigating the significant challenges of wasteful consumption and unauthorized entry in hostel restaurants. The proposed system employs machine learning processes and integrated hardware control[10]. It also implies that absolutely nobody needs to be there watching throughout the food being distributed, and only pupils and professors who have permission to go can get it. Automated mechanical dispensing must be used with immediate facial recognition and verification to make sure that the nourishment is given out quickly, fairly, and openly. The protocol has been tested and shown to be able to tell the difference between people who are allowed to be there and those who aren't. It also stops the same person from getting more than one plate in a single eating cycle. The proposed solution may be implemented in actual-life hostels given that it has a flexible architecture, good interaction between hardware and software, and straightforward integration issues. There are some issues, nevertheless they could potentially be fixed in a future version by adding cloud synchronization, wireless tracking and better recognition models. Ingeneral, what is being suggested is a cheap, flexible, and high-tech way to automate cleaning up in hostels. It could be used in schools on an enormous scale if it can be enhanced and expanded. It will assist a lot with trimming down on wasteful consumption, ensuring that things run with greater efficiency, and using material resources in a method that is healthier for the environment.

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