PROPOSALS INVITED FOR FABLAB

OPEN PROJECT SCHEME

Title of the Project:

FYE: A SMART ACCESS CONTROL AND REAL-TIME MONITORING OF CAMPUS COMPUTER LABS

By

Student Members

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Faculty Mentors

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1.	Title of the Project	:	FYE: A Smart Access Control And Real-Time Monitoring Of Campus Computer Labs
2.	Discipline under which the project is to be considered	:	Engineering & Technology
3.	Name & Designation of the Faculty Mentor	:	1. Dr. A. Alice Nithya Assistant professor 2. Dr. C. Lakshmi Professor 3. Dr. J. S. Femilda Josephin Associate Professor
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7.	Duration of the Project	:	1 Yr
8.	Total Cost of the Project Proposal	:	Rs. 2, 08, 300/-
9.	An abstract, describing the background, objectives, methodology & year-wise budget	:	To be enclosed separately (Annexure I)
10.	Whether the same Investigator(s) is/are receiving funds from any other agencies	:	No

ANNEXURE I

ABSTRACT

In the contemporary world, computer labs at universities are of great significance for students and faculties. Computer labs at the universities are used in three general circumstances: practical demonstrations, individual students work on projects and conducting exams. Each situation requires different authentication requirements, different network permissions, different access permission for resources and network, and so on. In order to perform these tasks, prevailing labs require several manual interventions to be made by personnel like network administrators to monitor and maintain the lab and resources. Though several smart solutions are in existence, to monitor and maintain resources and anomalous activities in the lab, human intervention is still required as the lab size or the number of users increases.

The proposed prototype, FYE, is a rational system designed by integrating three major computer science domains, namely computer vision, Internet of Things and network security to authenticate users, allocate systems, and monitor user activities and lab resources without manual intervention. FYE is specifically designed to suit the business-level use-cases related to individual students working on research projects in the computer labs. Those students willing to work in the lab must enroll themselves priorly.

During the enrolment phase, users face image will be enrolled to perform face recognition based authentication and attendance monitoring; user's requirements will be collected to provide access control and resource allocation. Four types of users will be predefined in this work, to provide different user requirements, ease the monitoring activity over the network and set group policies. All resources in the lab will have an RF transmitter installed in it to monitor resource movement inside or outside the lab.

During the authentication phase, users will be authenticated using a high-resolution camera sensor, thermal sensor, and PIR (Passive Infrared) motion sensor. These sensors are employed to monitor the entry/exit of users, authenticate them using face recognition technology, to maintain attendance of the lab users and count the number of entries/exits. When a user enters the field of view of the PIR motion sensor, they will be prompted to provide authentication. Lab users must authenticate their identity before entry or exit, by showing their face to the high-resolution camera planted near the door.

The proposed face recognition architecture uses computer vision algorithms like Histogram equalization, Weiner filter, Histogram of Oriented Gradients (HOG) combined with K-means segmentation and Convolution Neural Network architecture with Transfer Learning (CNN –TL). Each algorithm employed in this work is designated to perform unique tasks like blurredness detection and sharpening, detecting liveness of the user (face spoofing) and detecting obstacles present in the face if any to improve the input image quality and recognition accuracy. Preprocessing steps proposed in this work helps in reducing the computational cost of the CNN architecture.

During the authentication phase, users face will be registered through the high-resolution camera sensor present near the entry/exit line. An authenticated user will be given an option to select an available desktop or cabin with LAN provision for laptops through a smart monitor. This smart monitor is an LCD multi-touch monitor acting like an interface for the users to select the available systems. Thermal sensors and PIR sensor will constantly analyze the scene near the entry/exit to monitor the number of users gaining access to the lab at a time. An authenticated user will be allowed to accompany one more user if required. RF sensors will be installed to monitor the resource movement.

For authenticated users system number, and a one-time password will be displayed on the monitor for desktop users or a cabin number will be displayed for laptop users to use their own device. Once the laptop users connect their system to the lab LAN, a network password will be unicasted to them to use within the next fifteen minutes to gain access to the LAN. For all authenticated users login details will be sent to their registered mobile number or email and will be enabled for the next fifteen minutes only.

Once the authenticated user login to the system, network monitoring activity will begin at the backend. Since this work is proposed to monitor a lab for users doing research activities, network monitoring activities are limited to providing access to the resources, analyzing browsing patterns, monitoring/ recording users screen at a particular time interval. Based on the user type selected by an individual during the enrolment phase, group policies will be activated to work with system resources (both hardware and software). By using a fuzzy KNN algorithm, the user's browsing pattern will be analyzed and check for anomalies if any. Finally, the screen monitoring system runs randomly for a particular time limit, records data about some system information (for example logged-in username, CPU usage, temperature, list of processes) to a local file and uploads this file via SFTP to a configured location. If the screenshot service is running it can also upload the file with the current screenshot via SFTP.

Continuous monitoring of the lab will be done to find unregistered users and a warning will be sent to the admin by taking random images using the high-resolution camera. TCP/IP based communication medium is designed to integrate systems, camera, thermal camera, PIR sensor, and LCD display.

A simple single portal web application will be developed to monitor the aforesaid activities and make decisions accordingly. Based on the abnormal activity detected, actions, like freezing the screen, reducing user privileges, restricting access to premises and so on, will be done automatically.

The proposed prototype will follow a blackboard design pattern to provide a data-centric architecture with high functionality, maintainability, feasibility, usability, efficiency, and reliability to ease the lab monitoring process. By following industry-standard software architecture and design patterns, this prototype will improve the lab monitoring process and help the beneficiaries.

Keywords: Access Control List, Anomaly Detection, Image Blurredness Removal, Face Recognition, Lab Monitoring System, Liveness Detection, Resource Monitoring.

MAIN OBJECTIVES

The main objectives of the proposed smart access control and real-time lab monitoring system are as follows:

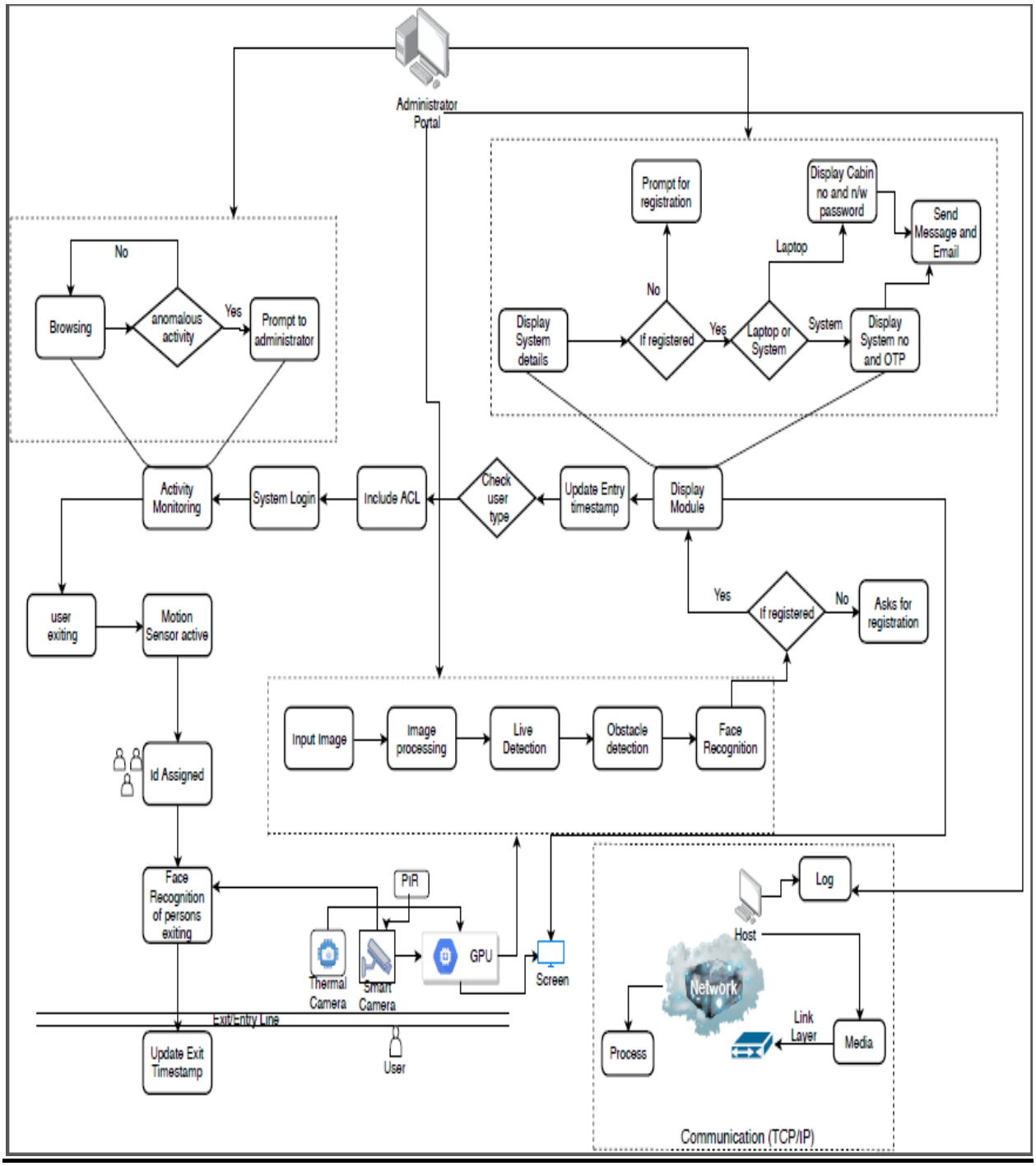
- To develop a face recognition system by checking image quality factors like blurredness, salt and pepper noise, the liveness of the user and masks or obstacles presence if any.
- To develop a smart login system to monitor and record system availability and user attendance.
- To develop a system that will monitor the computer activities of the user.
- To develop a system that has a restriction for other applications installed.
- To develop a system to detect the anomalous behavior of the user.
- To develop a system that will allow users to share resources.
- To develop a system that has a user-friendly, single portal interface for monitoring user activities and make decisions automatically.

FUTURE ENHANCEMENTS

Some of the future enhancements planned for this work are as follows:

- To provide a reliable online pre-booking system through app and web support.
- To assist the users using voice integration.
- To provide a chatbot to aid for any queries with the help of the assistant.

ARCHITECTURE DIAGRAM



PROJECT TIMELINE

One Year (Each Phase=2 months)						
MODULES	**PHASE 1**	**PHASE 2**	**PHASE 3**	**PHASE 4**	**PHASE 5**	**PHASE 6**
1. Feasibility study and Equipment Purchase						
2. Dataset Collection for facial Recognition						
3. Display Module & Activity Monitoring Portal Development						
4. Knowledge Base Development for ACL and Anomalous activities						
5. Liveness Detection Module Development						
6. Hidden Object Detection Module Development						
7. CNN with TL Model Development						
8. Anomaly Detection using Fuzzy kNN Module Development						
9. Integrating and Testing the Prototype to meet industry standards						
10. Analyzing Project Performance, Documenting Project Closure, Analyzing Team Performance and Accounting for used and unused materials and capital.						

DEVICE BUDGET DETAILS

S. No.	Device	Specification	Quantity in Nos.	Cost in Rs
1.	PTZ Camera	Hikvision 2MP PTZ Netwrok Dome Camera	1	53,000
2.	Thermal Camera	AMG833	1	5,000
3.	PIR Motion Sensor	Wall Mount PIR Sensor	1	5,300
4.	Display Screen	View Sonic TD1630-3-10 Multitouch Monitor	1	16,000
5.	GPU	nVidia Tegra X1945-82771-0000-000 Jetson TX2 Development Kit	1	85,000
6.	RF Sensor Transmitter & Receiver	433Mhz	200	24,000
7.	Miscellaneous (Fabrication, Outer cover, Network cables,PCB Board, etc.)			20,000
Total				2,08,300