# SSN College of Engineering

Department of Computer Science and Engineering

# CS1504 — Artificial Intelligence

2021 – 2022

**Assignment — 01**

July 20, 2021

1. Give a PEAS description of the task environment for each of the following activities. Include detailed write-up on each aspect of the task environment.
   (a) SSN wants to develop and deploy a face-recognition based smart attendance system for its employ- ees and students. Provide a detailed PEAS description for the same.

| Agent Type | Performance Measure (P) | Environment (E) | Actuators (A) | Sensors (S) |
|---|---|---|---|---|
| Face-Recognition Based Smart Attendance System | Face detection,<br>Face recognition<br>Latency | Amount of people in environment | Speaker<br>Display screen | Camera,<br>Proximity sensor,<br>Keypad buttons |

**Descriptions**

- Performance Measure
  - *Face detection*: Ability to detect the presence of a face. In an empty surrounding, it must switch into standby mode. In a crowded surrounding, it must detect and track one most prominent face. Should not treat a photograph as a face.
  - *Face recognition*: When a prominent face is detected, it must be able to correctly recognize and match the face to an employee/student of the college. Must not miss-identify or fail to recognize any person.
  - *Latency*: The rate at which the system can detect, identify and register attendance in the database is crucial to manage large crowd of employees/students since the nature of usage will entail extensive usage at a specific band of time and can become a bottleneck to the entire college schedule

- Environment

    - *Amount of people*: The number of people or the extent of crowdedness will differ at different points of time. The system must be able to detect a single prominent face in case of crowds and go into standby mode when there is no-one around

- Actuators

    - *Speaker*: The system can have a beep sound or announcement of the employee name and attendance time to serve as a feedback mechanism to confirm attendance being marked

    - *Display screen*: The system should have a screen displaying the camera's view, so that the employee/student can align his face accordingly if the system is not able to detect the face. Further, it must display the name, time and date information of the system as a feedback mechanism and to detect if the time information concurs with the college time at all times.

- Sensors

    - *Camera*: A camera is essential to obtain serial input data of the system's surrounding, from which faces can be detected and identified

    - *Proximity Sensor*: When the system is in standby mode, it must detect the presence of a person/object close to it, switch to active mode, check if it is a face and carry out its detection and identification routine.

    - *Keypad buttons*: Minimal buttons on the system that must be clicked by the employee/student as a feedback mechanism. When the system identifies the person, it must display and/or announce the person's name and identification. The person can check if this information is correct and click a button to confirm or inform the administrator that there has been a mis-identification

(b) SSN wants to develop and deploy an online autonomous proctoring system that can monitor $n$ students through a video communication channel. Provide a detailed PEAS description for the same.

| Agent Type | Performance Measure (P) | Environment (E) | Actuators (A) | Sensors (S) |
|---|---|---|---|---|
| Online Autonomous Proctoring System | Face presence and orientation detection,<br>Face detection,<br>Voice / Noise differentiation,<br>Low Network Bandwidth requirement<br>Latency | Amount of people in each environment,<br>Amount of noise in each environment<br>(One environment corresponds to one student) | Display screen,<br>Speaker | Camera,<br>Microphone,<br>Keyboard/Mouse |

**Descriptions**

- Performance Measure

  - *Face presence and orientation detection:* The system must be able to detect the presence of a face in the camera's range. It must ensure that only one face is present. It must ensure that the face is looking within an estimated screen region. Should not treat a face in a photograph as valid.

  - *Voice/Noise differentiation*: The system must be able to monitor the sound input of the mic, ensuring the presence and active state of the microphone. It must estimate a normal level of background noise. It must be able to detect voices or other potential noises that cause deviation from the normalized noise level to detect malpractice.

  - *Low network bandwidth*: The system should be able to relay all the collected video and sound data between the server and client system rapidly but with minimal network bandwidth requirement. It should be able to adapt to / tolerate slight network fluctuations. This is crucial to ensure that all students are able to attend the exam hassle-free

  - Latency: The system must have minimum delays during student interactions such as while switching questions, clicking on an option, typing out an answer, etc. This must be given a higher priority than audio/video transmission during network bandwidth fluctuations to ensure that students get a fair attempt at the examination

- Environment

    - *Amount of people*: In each of the n student environments, the system should ensure that there is only one person in vicinity and that this is the intended student. In case of more people or no person, it should take suitable warning and reporting measures.

    - *Amount of noise*: In each of the n student environments, the system should ensure that the noise does not go beyond a normalized level (which could be pre-estimated or dynamically evaluated for each student environment). It should take suitable warning and reporting measures when there is excessive noise or a human voice is detected
- Actuators

    - *Display screen*: Each student must contain a display screen to display the questions, warning for excessive noise and absence of face in frame and also to show a preview of their video recording as a feedback mechanism. This will allow a student to respond and make changes to his/her posture when there is a warning raised by the system.

    - *Speaker*: A speaker in each student environment can be useful in raising auditory warnings if the student doesn't notice visual warnings. Furthermore, it should be able to differentiate between noise and the system's warning sound.

- Sensors

    - *Camera*: Each student system should contain a camera to constantly monitor their video for the detection and recognition routines.

    - *Microphone*: Each student system should contain a microphone to constantly monitor the sounds/noise/voices in the environment

    - *Keyboard/Mouse:* Each student system must contain a keyboard and/or mouse to allow students to interact with the system to login, answer questions and submit the test

(c) SSN wants to develop a team of robotic agents to participate in Robocup soccer competition (`https://2021.robocup.org/`. Provide a detailed PEAS description for such a robotic agent.

| Agent Type | Performance Measure (P) | Environment (E) | Actuators (A) | Sensors (S) |
|---|---|---|---|---|
| Team of Robotic Agents that Play Soccer | No of goals scored,<br>No of goals saved,<br>No of successful ball tackles from opponent player<br>Speed of play | Soccer field,<br>Soccer ball,<br>Teammates,<br>Opponents (Human / Robot) | Movement wheels and programmable motor,<br>Lever to strike, tackle, stop the ball | Camera,<br>Proximity sensor |

**Descriptions**

- Performance Measure
    - *No of goals scored*: The number of goals scored by the individual roibot and by the team as a whole can be used to analyse the attacking quality of the team and its ability to coordinate for this objective
    - *No of goals saved*: The number of goals saved by the individual robot (esp. the goal-keeper) and by the team as a whole can be used to analyse the defending quality of the team and its ability to coordinate for this objective
    - *No of ball tackles*: The number of tackles and snatch of the soccer ball from the opponent player can be a measure of the ability of the robot to observe the play of the opponent player and make strategic decisions to predict and gain control over the soccer ball
    - *Speed of play*: The speed of the general play will influence and help to understand the processing speed with regard to making decisions based on the perception of the field. It can help to decide on improving processing capabilities so as to match with the opponents rate of decision making
- Environment
    - *Soccer field*: Each robot must be able to judge the boundaries of the playing field. It must ensure to keep the ball within the bounds and understand the aim of directing the ball to the correct goal post and keeping it away from the other

- *Soccer ball*: The soccer ball must be understood and constantly tracked by each robot to keep track of the gameplay.

- *Teammates*: Each robot must be able to identify its teammates from any given position and make strategic decisions to pass the ball to the right teammate or decide to retain

- *Opponents*: Each robot must be able to identify an opponent from any given position and make strategic decisions to keep the ball away from the opponent by taking a suitable course of action. Depending on the type of opponent (human or robot), appropriate identification methods should be applied.

- Actuators

  - Movement wheels & Programmable motor: Each robot must posses movement wheels under the control of a programmable motor (say, a stepper motor) to move around to any part of the field

  - Lever: Each robot must posses a lever or rigid rod like structure that is capable of making at least a one-dimensional motion to strike the ball, defend the ball and tackle the ball from the opponent player

- Sensors

  - Camera: Each robot must have a camera, constantly monitoring the playing field, identifying its teammates and opponents, keeping track of the ball and the gameplay. This information will be used to make decisions as per current scenario.

  - Proximity Sensor: The robots must be able to detect a player approaching from somewhere out of its camera-range as well as obstacles and boundaries of the playing field to make suitable decisions