Info Myanmar College

HND

Unit 16: Computing Research Project

Research Project on the Artificial Intelligence

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Htet Zaw Paing

Batch – 105

2nd Year, 2nd Semester

Start Date 01.09.2025

End Date 23.09.2025

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LO1: Examine appropriate research methodologies and approaches as part of the research process.

P1: Produce a research proposal that clearly defines a research question or hypothesis supported by a literature review.

Introduction

A Smart Entertainment Bot That Recognizes Facial Emotions and Reacts with Gestures, Music, and Notifications, is a project that aims to integrate artificial intelligence and IoT technology to implement an engaging and interactive system. Emotion recognition has come into existence to improve human-computer interaction currently, which has evolved to be more advanced. This project combines facial emotion detection to tell the user in real-time how he is feeling and act upon it (e.g., by using a servo motor to gesture, showing messages on an OLED display, or playing appropriate music). This is not merely to entertain but also to examine how AI-powered emotion recognition can help improve user experiences by ensuring interactions with machines become more natural and more human-like. The project integrates AI and IoT devices and feedback mechanisms to demonstrate how smart systems can be applied to both personal and social contexts.

Research Proposal Form

Student name	Htet Zaw Paing	Student number	
Centre name	Info Myanmar College	Date	15.5.2025
Tutor	Dr. Moe Arkar Lwin, Daw Thae Nandar Aung		
Unit	Unit 16: Computing Research Project		
Proposal title	AI-Powered Intelligent Emotion Recognition and Adaptive Response Recommendation System		

Section One: Title, objective, responsibilities
Title:

AI-Powered Intelligent Emotion Recognition and Adaptive Response Recommendation System

Aim:

The purpose of this project will be to offer an intelligent entertainment system that has the ability to identify the emotion of a human face in real-time using the deep learning models and facially reacts to this interaction in an interactive way by using expressive facial gestures, music recommendations, and personalized messages. The goal is to reach the users, amuse in mood and demonstrate how the emotion-aware systems can improve the daily life. Such system would also assist in molding intelligent, adaptive interfaces that can learn and react to the innate human passions.

Objectives

- To design and develop a facial emotion-recognition framework that uses convolutional neural networks (CNNs) and can provide recognition results with a high level of accuracy of a complete range of human affective.
- To include in the stated architecture a real-time pipeline where video input that is live will be processed, facial data retrieved, and emotion-labeled with minimum lag.
- To integrate the emotion-detecting component into a gesture-control system which allows the system to physically react to emotion (e.g. nod snapping, waving).
- To complement emotion detection with a mood-based music recommendation engine that will pick audio content matching the emotion identified.
- To choose these physiological states to be on notification or alert with the purpose to improve the wellbeing of the user.
- To consider in quantitative assessment the accuracy of detection, fast processing speeds, and user satisfaction.
- To optimize the interface to be easy to use and to convey emotions detected, suggested content and actions performed by the system in a way that can be understood easily.

- To investigate specifically which of the facial identifications give the biggest input on the overall correctness of face recognition.

Research Questions:

- What is the effectiveness of the system of matching the detected emotions with appropriate music and gestures?
- Which facial features are most influential toward enhancement of the accuracy of the emotion recognition model?
- How does the interactive response (gestures, music, notifications) influence user mood and engagement?
- Is it possible to create a smart entertainment bot that would promote stress relief and pleasant user experiences?
- What are the technical or ethical issues with using emotion-aware systems in a home or in the street?
- How can this way be compared with the traditional static systems of entertainment in personalization and satisfaction of the user?
- What problems or privacy worries could happen if this emotion-aware bot is used at home or outside?

Hypothesis:

- Facial emotion recognition through deep learning will be more accurate as compared to the conventional methods of expression detection.
- The emotion recognition in real time will make the entertainment more interactive and personal through gesture response and music suggestion.
- Emotion-aware notifications can assist users to be more aware of their emotional status and live healthy.
- Detecting the important facial characteristics (region of eye, mouth curvature) will largely improve the detection rate of the model.
- It will be proven that the smart entertainment bot will show an improvement in the mood and quality of interactions with users, which will be measured against the passive entertainment systems.

Section Two: Reasons for choosing this research project

There are several reasons for choosing the project of "**AI-Powered Intelligent Emotion Recognition and Adaptive Response Recommendation System**"

- My interest in the topic is personal because I think about how the application of artificial intelligence should make technology more human and responsive. This project also allows me to work on something creative and practical in reality, that is, a bot that can understand feelings and gesture, music, and notification.
- The project relates closely to topics I am already learning in college such as deep learning, computer vision, and software engineering and provides me with an opportunity to implement such principles as CNNs, real-time video processing, and HCI.
- I am interested in developing my proficiency in Python and frameworks of machine learning (TensorFlow or PyTorch) and working with tools such as OpenCV to make real-time face detect and advance my ability to make interactive interfaces to pair AI with the outputs like gestures and music.
- My future career aim is to be a part of AI and intelligent system development, in particular, where technology meets people in innovative ways and this project helps in that regard, as it puts an emphasis on emotion-sensitive intelligent systems.
- I think we can enhance people everyday life via the introduction of emotion-aware technology, to make devices more supportive, help them reduce stress by improving mood through music and friendly communications, demonstrating how the AI could make digital interactions more meaningful and human-like.
- This is a great chance to be creative and merge all mentioned features in one project and make a bot that reads moods and reacts to them to make people feel in good hands and entertained.

Problem Statement

The modern world is a very busy place, and to live and work in it, a great number of users experience stress, loneliness, and an emotional-burnout but cannot find a personalized support structure in the context of day-to-day technology. Entertainment systems do not align to the moods of users so interaction with

digital means is inferior to give a meaningful meaning, and at times a negative mood is enhanced. In addition, the number of available and inexpensive solutions, which can detect real-time emotional states and react to enhance wellbeing, is limited. Such a gap restricts the extent to which technology can enhance mental well-being, relaxation, and the interaction with the user in everyday life.

Proposed Solutions:

- Create a CNN-based solution capable of correctly recognizing even a very broad variety of emotions on the face of the user on the video stream in real-time with very little delay so as to be able to respond to the feelings of users as fast as possible.
- Implement gesture control to enable the bot to display a physical reaction by means of gestures (e.g. nod or wave) on the user to make the interaction feel natural and even deeper to identify with, making the user feel listened and understood.
- Introduce a smart music recommendation system that will be able to choose a song depending on the mood of the user so that it could help remove stress and bring a smile to the face by providing similar audio content.
- It should be a simple, accessible interface, on which detected emotions and the action of the system are viewable, so that the technology would be easy to use by people of any age and technical expertise.
- Test the accuracy, responsiveness and satisfaction with the measurement systems in real-life conditions, so that the bot would contribute to emotional wellbeing and engagement.

Section Three: Literature sources searched

In the present review, the recent studies of facial emotion recognition (FER) and its application in interactive entertainment are examined. The most common way to classify human facial expressions using deep learning, especially convolutional neural networks (CNNs), is through transfer learning, better loss functions, and data augmentation, which are methods

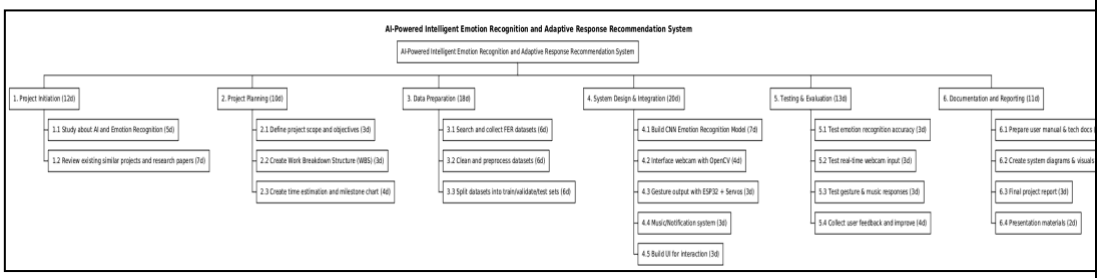
performed by many researchers. As an example, Zhai et al. (2017) achieved an accuracy of high levels on popular FER datasets with the help of CNN-based model with modification of softmax-MSE loss and two-activation layers. In other research papers, there is the unraveling of how the identified emotions can result in various responses of the systems. Taking an example, Pedapaga et al. (2022) outline a Python and OpenCV pipeline that takes pictures with a webcam, gets an emotion through Keras CNN, and then recommends playlists with music to correspond to the mood. The moderately accurate range of such systems is typically between 50-70% and they are typically characterized by constraints in emotion labels and overfitting. In general, this piece of work provides us with a foundation of building our smart bot. It demonstrates that CNNs (with TensorFlow or PyTorch) can be already applied to real-time FER, however it notes that real-time processing needs to be more reliable and the output more descriptive, which has not yet been fully implemented (gestures, alerts etc).

References

[1] https://link.springer.com/chapter/10.1007/978-3-319-71607-7_19
[2] https://www.sciencedirect.com/science/article/pii/S1877050924008731
[3] https://www.irjmets.com/uploadedfiles/paper/issue_6_june_2022/27381/final/fin_irjmets1656670953.pdf

Section Four: Activities and timescales

Work Breakdown Structure



Time Estimation

Activity/Task	Estimated Time Duration	Predecessor

1. Project Initiation	12 Days	
1.1 Study about AI and Emotion Recognition	5 Days	-
1.2 Review existing similar projects and research papers	7 Days	1.1
2. Project Planning	10 Days	
2.1 Define project scope and objectives	3 Days	1.2
2.2 Create Work Breakdown Structure (WBS)	3 Days	2.1
2.3 Create time estimation and milestone chart	4 Days	2.2
3. Data Preparation	18 Days	
3.1 Search and collect FER datasets	6 Days	2.3
3.2 Clean and preprocess datasets	6 Days	3.1
3.3 Split datasets into train/ validate/ test sets	6 Days	3.2
4. System Design & Integration	20 Days	
4.1 Build CNN Emotion Recognition Model	7 Days	3.3

4.2 Interface webcam with OpenCV	4 Days	4.1
4.3 Gesture output with ESP32 + Servos	3 Days	4.2
4.4 Music/Notification system	3 Days	4.3
4.5 Build UI for interaction	3 Days	4.4
5. Testing & Evaluation	13 Days	
5.1 Test emotion recognition accuracy	3 Days	4.5
5.2 Test real-time webcam input	3 Days	5.1
5.3 Test gesture & music responses	3 Days	5.2
5.4 Collect user feedback and improve	4 Days	5.3
6. Documentation and Reporting	11 Days	
6.1 Prepare user manual & tech docs	3 Days	5.4
6.2 Create system diagrams & visuals	3 Days	6.1
6.3 Final project report	3 Days	6.2
6.4 Presentation materials	2 Days	6.3
Total Estimated Days - 84 Days		

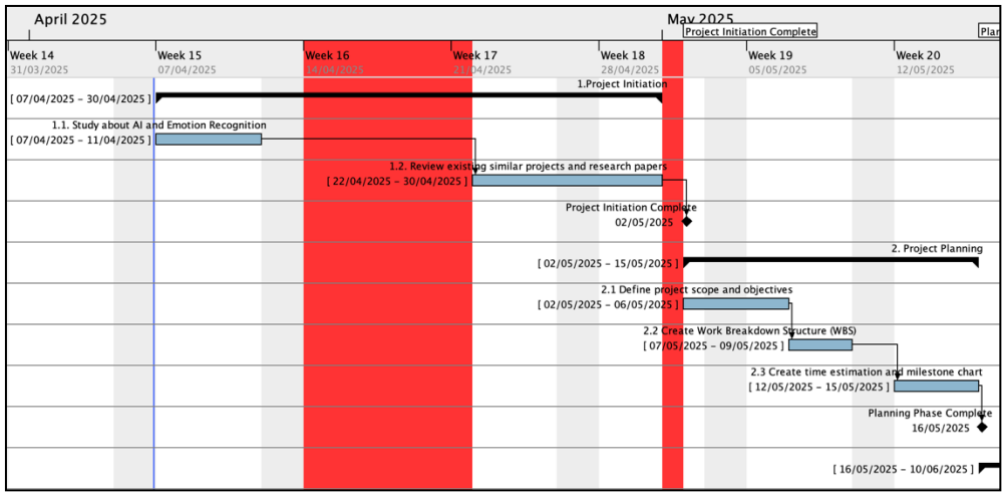


Figure 1.1 Gantt Chart for the Project

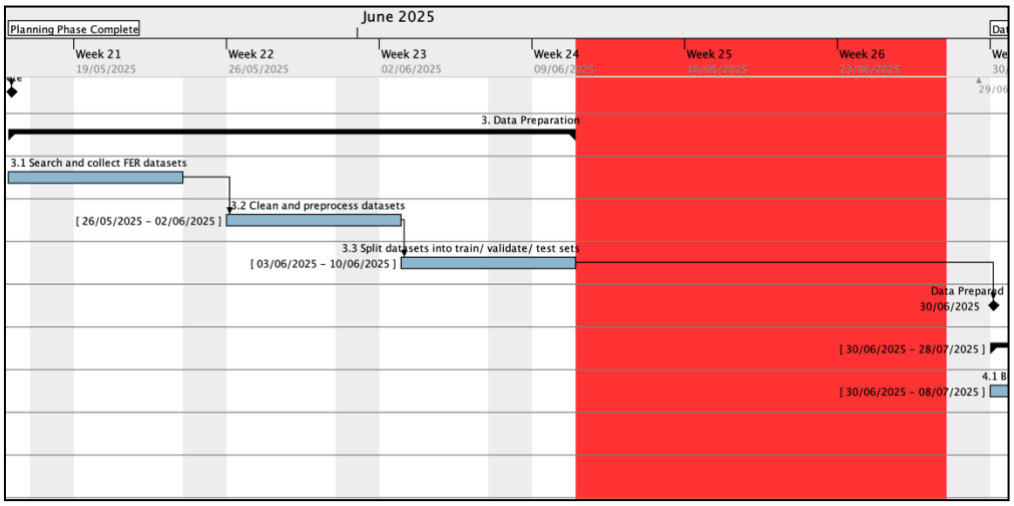


Figure 1.2 Gantt Chart for the Project

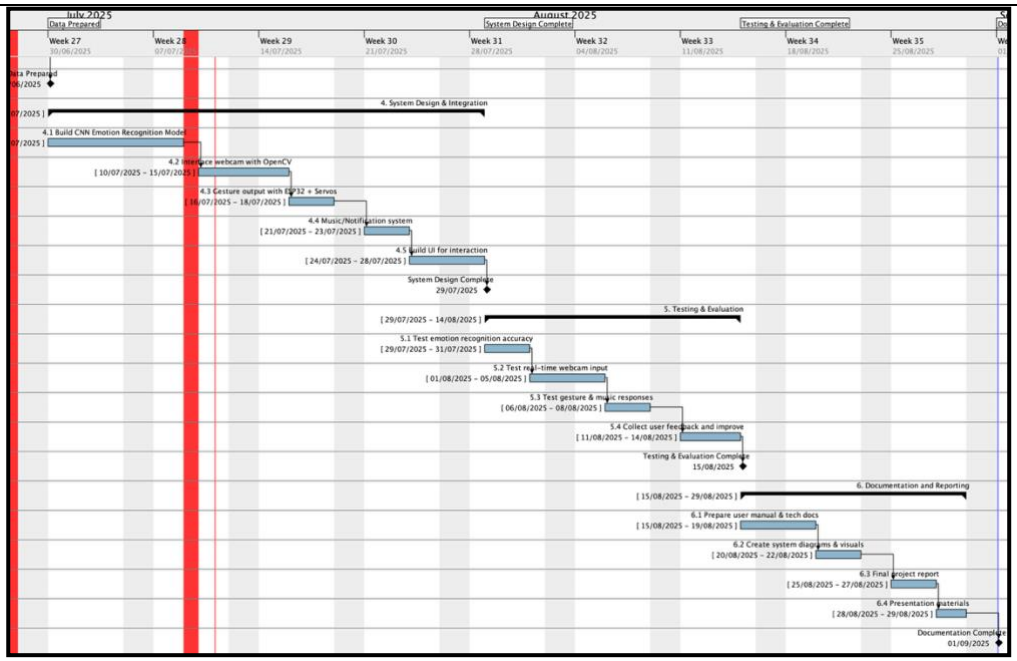


Figure 1.3 Gantt Chart for the Project

Milestone one: Project Initiation Completed

Target Date: 2/05/2025

Milestone two: Planning Phase Completed

Target Date: 16/05/2025

Milestone three: Data Prepared

Target Date: 30/06/2025

Milestone four: System Design Completed

Target Date: 29/7/2025

Milestone five: Testing and Evaluation Completed

Target Date: 15/08/2025

Milestone six: Documentation Completed

Target Date: 1/09/2025

Section Five: Research approach and methodologies

Research Philosophy: Pragmatism

The project is associated with the development of practical solutions that enhance the user experience and wellbeing using emotion-aware technology. Pragmatism fits well in this objective as it rather focuses on the practicality and applicability of knowledge acquired out of objective information and also out of subjective user responses. It enables you to find a balance between technical correctness and human-focused designing needs and is therefore very suitable to a system that will connect with actual users in dynamic settings.

Research Approach: Deductive

The bot establishes theories under deep learning, computer vision, and human-computer interaction in developing it. Such theories are applied in the project where they act as models (such as CNNs) to sense and react to emotions. It, therefore begins with speculations about how user experience can be improved by emotion recognition and responsive gesturing/music, and puts them to test systematically.

Research Strategy: Prototype Development and User Testing

Prototype Development:

Train and construct the emotion recognition model and combine it with gesture controls and feed it to the music recommendation system. This is an experimental process where improvement upon improvement can be made after observing the performance of the system.

User Testing:

Examine user feedback in user studies using controlled variables which will provide qualitative and quantitative information about the effectiveness of the bot in detecting feelings, adequacy of responses, and influence on the users in terms of mood and engagement with the bot.

Mixed-Methods Research Choice

The current project uses a mixed-methods implementation, as we would correlate quantitative variables, i.e., the accuracy of emotion recognition, latency, and number of accurate music-to-emotion matches with qualitative data: the results of interviews or questionnaires with users and the observations of their behavior. Such a combination allows grasping both the technical success of the system and its direct impact on the emotional wellbeing of the users.

Time Horizon: Cross-Sectional Study

Since the project aims at a test that shows how well the bot can detect emotions and respond in real time, a cross-sectional study also applies. This involves the assessment of system performance and satisfaction of a user at one point in time or at a specific, test engagement involving various users. This method provides a practical design within a short period in providing a feasibility response to detection accuracy, gestural response, and music suggestion mechanisms in different users and situations. A cross-sectional design will be useful during the early development phase to determine the instant strengths and weaknesses without involving long-term observation.

Comments and agreement from tutor

Comments (optional):

I confirm that the project is not work which has been or will be submitted for another qualification and is appropriate.

Agreed: (Name) (Date)

Comments and agreement from project proposal checker (if applicable)
Comments (optional): I confirm that the project is appropriate. Agreed: (Name) (Date)

P2: Examine appropriate research methods and approaches to primary and secondary research.

Research Methods

Research methods are the systemic procedures and methods by which researchers gather, examine and understand data to respond to certain questions, challenge theories or to resolve a problem. They give the structure of the research process and provide the validity, reliability and significance of the findings (Kothari, 2004).

Data in research may be gathered in two primary and secondary research ways. Primary research is the collection of new data in its original form, i.e. as a survey, interview, or experiment, whereas secondary research is the use of existing data in the form of a book, article, report, or database. The Research Onion framework is frequently used by researchers to determine the appropriate approach by offering a systematic method to decide the approach, strategy, philosophy, and data collection method that is most appropriate. Using the Research Onion, the researchers are able to ascertain the extent to which a primary, secondary or a combination of the two methods in their research was suitable (Saunders, Lewis & Thornhill, 2019).

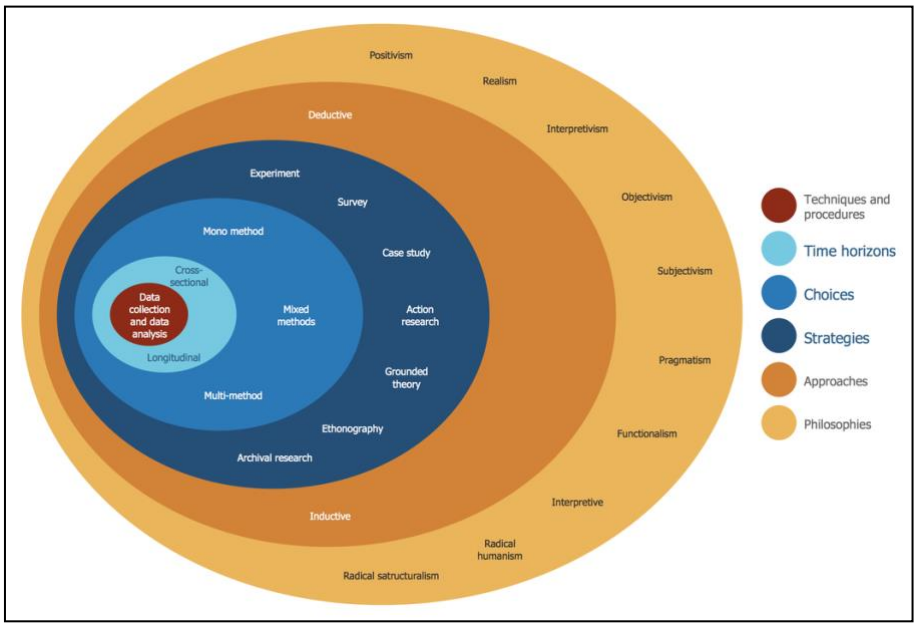


Figure 1.4 Research Onion

Research Onion

The model that was developed by "Saunders et al." to help a researcher organize their study in a step-by-step way is the research onion. It is made up of layers that include philosophy, approach, strategy, time horizon and collection methods of data. The layers are each a choice that influences the process of the research. The layers allow researchers to create clarity and consistency by peeling through them to ensure good design (Saunders et al., 2019). In conclusion, the research process can also be explained through the Research Onion, which consists of six main steps:

1. Research philosophy
2. Research approach
3. Research strategy
4. Research choices
5. Time horizon
6. Data collection techniques

Research philosophy

Research philosophy is a collection of beliefs and assumptions that inform the way knowledge is created, interpreted and used. It determines how a researcher perceives the world and determines the selection of methods and techniques in research. There are three general components of philosophy of research:

- **Ontology** - is concerned with the nature of reality and with that which can be known to be true. It includes the question of the existence of social phenomena without the perceptions of people (objectivism) or influenced by human experiences (subjectivism).
- **Epistemology** - the nature of knowledge, how it is possible to attain. It deals with what is considered as valid knowledge, be it facts that are measurable (positivism) or meanings (interpretivism).
- **Axiology** - deals with the question of research values and ethics. It recognizes that researchers are carrying their beliefs and judgment into the study that may affect decisions and interpretations.

Collectively, these aspects make certain that the research is being carried out with an understanding of how knowledge is defined, collected, and judged (Khatri, 2020).

Research Approach

The research approach is the general plan which relates the research philosophy to the data collection and data analysis methods. It demonstrates the way the research passes through the questions to conclusions. There are two primary methods, which are inductive and deductive.

- Deductive Approach: It is a top-down approach. The researcher begins with a given theory or hypothesis and provides them with data. As an example, when a theory provides that ultrasonic sensors are accurate in detecting obstacles, experiments can validate this. It is organized, quantitative in nature, and gives straightforward outcomes. The deductive approach was mainly used in this project (Saunders et al., 2019).

Research Strategy

Research strategy is the method that a researcher is going to use to gather and analyze data to answer their research questions. It is a link between the research design and method in which the research will be undertaken to ensure that the research follows a methodological discipline and that the research is as objective as possible. Various techniques are selected depending on the type of research problem. Experiment and survey will be employed in this project, the experiment will test the technical perfection of the system and the survey will obtain the opinions of users about the system in relation to its usability and effectiveness (Creswell & Creswell, 2018).

Experiment

An experiment controls and manipulates variables in order to test cause and effect. Which means that it allows researchers to observe the effects of one thing having an impact on another under controlled conditions. This type of approach is effective in scientific and quantitative type of research.

Survey

A survey is used to obtain data from a large number of people, through questionnaires or interviews. It is widely used to study minds such as mindset, habits or traits. The benefits of surveys are that they are low cost and easy to analyze.

Research Choice

The fourth layer of the Research Onion is decisions related to the research methods, that is, qualitative or quantitative methods. Quantitative research involves the use of numeric data and statistics whereas qualitative research involves the gathering of detailed and descriptive information in terms of opinions, behaviors and experiences. The selection of the methodology will be based on the research problem, goals, and the general study design. The mixed-methods will be applied in this project because of the combination of experimental findings with survey-based knowledge (Saunders et al., 2019).

Mixed-Methods

Mixed-method studies involve both the qualitative and quantitative data in equal measure. A study as an example can use surveys and gather statistics and interviews to explore personal experience. This alternative is conclusive because it replaces the numbers with an even deeper disclosure and eradicates the failure that exists in the application of a single method.

Time Horizon

The fifth layer of the Research Onion is related to the period of the research study. It gives an indication of whether a researcher will gather data at a given moment or whether he will be studying it over a long period of time. These are cross-sectional and longitudinal studies, and either of the two may be quantitative or qualitative. In this project, both experimental and survey data will be collected at a given point in time by a cross-sectional approach (Bryman, 2016).

Cross-Sectional

Cross-sectional are studies that survey a population (or populations) at a given time. As an example, a cross-sectional study is the process of measuring the level of stress in students during exams. This design is applicable in offering a snapshot or comparison between groups but not changes across time.

Data Collection and Analysis

The last layer in the Research Onion centers on the way some data is collected and analyzed in order to declare the research question answered. The identification of sample group, questionnaire design, interview questions, and selection of suitable

observation technique are some of the essential decisions that are made during this phase. This stage should be carefully planned so that the data gathered will be reliable, valid and will be analyzed.

The process of data collection should be consistent and credible with the previously decided philosophy, approach, strategy, and time horizon. After the data has been gathered, it is then analyzed to determine patterns, relationships, or themes with a quantitative study using statistical methods or a qualitative study using coding techniques.

This step works well since it can turn the raw information into relevant findings that could be applied to provide information that can be used to support conclusions, offer evidence, and add value to the research field (Kothari, 2004).

M1 Analyze different research approaches and methodology and make justifications for the choice of methods selected based on philosophical/theoretical frameworks.

Research Philosophy

When formulating this project, the three philosophical dimensions of the research onion, viz., ontology, epistemology and axiology were taken into account.

- Ontology: In the project, it is assumed that collisions with objects and the existence of obstacles are objective facts which can be captured by thickness measuring devices and IoT sensors.
- Epistemology: Knowledge is created by means of empirical testing of the performance of the system and by collecting feedback of the participants (surveys).
- Axiology: Ethical issues were prioritized, also including participant consent, and confidentiality also reporting the findings in good faith and fairly.

This philosophical basis supports the use of a scientific, but ethically accountable method to study collision avoiding technologies. With this strategy, the project will have the advantage of having credible and accurate data, a better credibility of the findings and the confidence that the ethical principle is strictly followed, which augments the validity and the acceptability of the study within the society.

Research Approach

The project follows the deductive research approach because it will test the available theories on collision detection and IoT systems. Theories like the ability of ultrasonic sensors to provide results in real-time object detection were developed and tested in experiments.

Nevertheless, there is also an inductive component, as new knowledge and concepts were revealed through the analysis of responses of the participants. In general, the prevailing method is deductive, because it starts with theory and tries to verify it by practical evidence. This will make the findings theoretically informed but at the same time, new practical knowledge will be discovered.

Research Strategy

In this project, two main strategies were used:

- Experiment: Controlled experiments were performed to assess the technical functionality of the IoT-based system in terms of the detection accuracy, response time, and consistency.
- Survey: Survey was issued to participants so that their opinion, trust level and ease of use with the system can be collected.

The experiment and survey were combined in order that both technical and user-centered factors of the system could be considered comprehensively. This two-sided strategy will guarantee fair evaluation, both in terms of objective performance indicators and the subjective user views.

Research Choice

A mixed methods design was undertaken.

- Quantitative data was collected from system testing (i.e., evaluation of obstacle detection accuracy), and rating scale survey responses.
- Open-ended survey questions were used to collect qualitative information about the respondents' experiences and suggestions.

Together, these two things produced both quantitative evidence and qualitative insights into the project outcomes. It is a holistic methodology that combines both quantitative technical results and qualitative insights that are rich in content and inform system enhancement.

Time Horizon

The research design was cross-sectional in that data were gathered at one point in time over the course of the academic project. This was reasonable given the short time frame associated with the project. It is beneficial in terms of data collection which is efficient within a short period of time, and gives timely information on evaluating the system. A long-term horizon was not feasible, but could be considered for future long-term system performance studies.

Data Collection and Analysis

The information used in this project was collected using technical experiments and survey questionnaires.

- Quantitative Data: Accuracy of obstacle detection, sensor response time, as well as motor actuation time were also recorded as measures of performance of the system. Structured surveys also used rating scales to gather the feedback of the participants. These data were discussed and displayed in forms of charts.
- Qualitative Data: Open ended survey questions were used to gather the ideas of the participants in terms of usability, system responsiveness and their views on how the system could be improved. Thematic analysis of the responses was done to determine common patterns.

Through quantitative and qualitative studies on the project by taking a combination of both quantitative and qualitative feedback on the participants, the project obtained a whole picture of the system effectiveness individually on technical and user-oriented basis. This incorporation makes sure that the decisions made on system enhancement are evidence-based, reliable, and user-friendly.

Justifications for the Choice of Methods

The project used the research onion to outline the project in a systematic manner. The use of interpretivism enabled human perspectives to supplement technical testing and the deductive approach ensured the focus on clear objectives and hypotheses. The mixed methods approach that involved quantitative data on the systems and qualitative user responses and the cross-sectional design allowed the collection of data in a timely manner.

The possible subjectivity of interpretivism, rigidity in deductive reasoning, time and hardware restrictions in experiments and the additional workload of mixed methods were some of the limitations. Nevertheless, the selected combination was systematic, feasible, and balanced with the assurance of reliable, ethically correct, and practically useful results.

LO 2: Conduct and analyze the research relevant for a business research project.

P3. Conduct the primary and secondary research using the appropriate methods for a computing research project that considers costs, access and ethical issues.

Primary Research

Primary research means gathering new and original information from people or sources firsthand by using one or more of the following methods: survey, interview and/or experimentation. It gives data specific to the project (Kothari, 2004).

The primary study for this project was conducted in the form of surveys to know the user expectations and opinions about an AI-powered entertainment bot, which detects facial emotions and reacts with gestures, music and notifications. Questionnaires were drawn up and distributed to potential users, such as students and general users with more or less technical knowledge. The survey included both closed and open-ended questions to collect quantitative information, such as awareness of emotion detection systems, willingness to use AI-driven entertainment solutions and trust in automated responses, as well as qualitative feedback like desired features, privacy concerns and feedback on music or gesture preferences.

This method allowed for the project to directly receive input from the target audience who would realistically interact with such a system. The responses collected gave valuable information about how comfortable users were with the system recognizing emotion, their expectations for how accurate the system might be, and possible ethical issues such as data privacy. It also directed the possibility of adding IoT components like servo motors for gesture and OLED screens for visual feedback. By using surveys as the main research method, the project made sure that the design choices made in the project were user-centered, practical and real in their need of entertainment, which ultimately made the bot more engaging and socially relevant.

Secondary Research

Secondary research involves using information that has already been collected by others in the form of books, articles, reports or on the Internet. It helps in

understanding the background knowledge and helps consume less time (Saunders et al., 2019).

In project, secondary research was used to provide the theoretical basis for the development of the smart entertainment bot. A review of academic articles, journals, and online resources was performed on the topics of facial emotion recognition techniques, deep learning models (e.g. MobileNetV2), and real-time IoT integration. This research was also done in the past with projects in which robots interacted with humans through gestures or sound, where they found difficulties such as accuracy, false detection and responsiveness. Insights gained from existing studies drove the system design, helping to avoid common pitfalls and inspire new improvements as well, such as integrating music responses with emotion-based notifications.

Survey Questions of the Project

To gather user insights for this project, a structured survey was designed and distributed using Google Forms. The survey aimed to collect feedback on participants' experiences, perceptions, and expectations related to the system. By using this method, responses were collected efficiently and organized for analysis, ensuring that the data reflects diverse opinions and supports the evaluation of the project's objectives.

Question 1

Figure 2.1 Survey Question for Question Number 1

Question 2

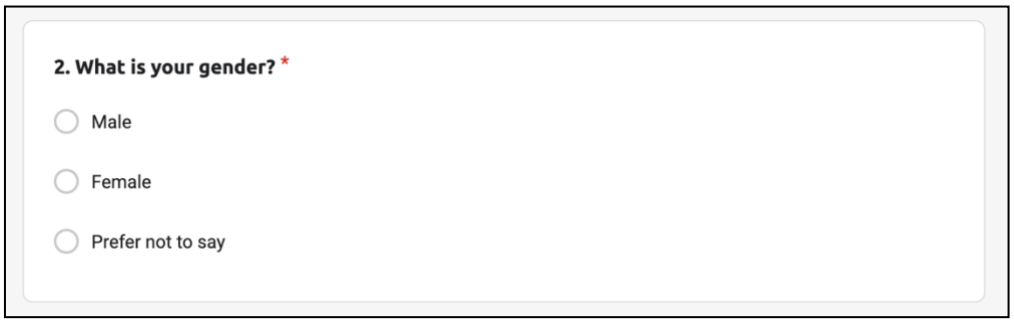


Figure 2.2 Survey Question for Question Number 2

Question 3

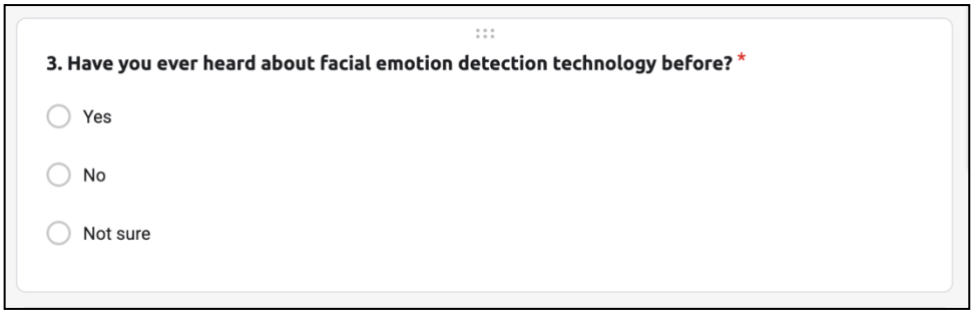


Figure 2.3 Survey Question for Question Number 3

Question 4

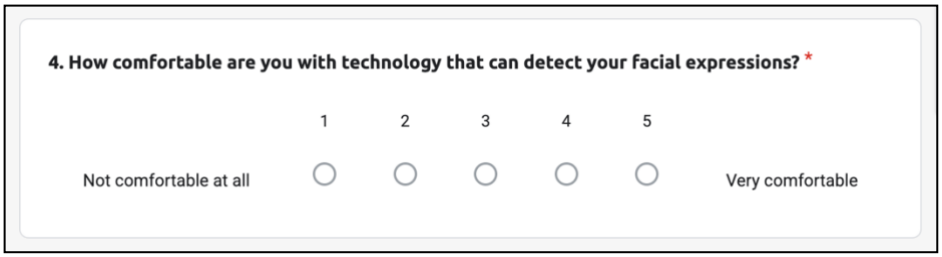


Figure 2.4 Survey Question for Question Number 4

Question 5

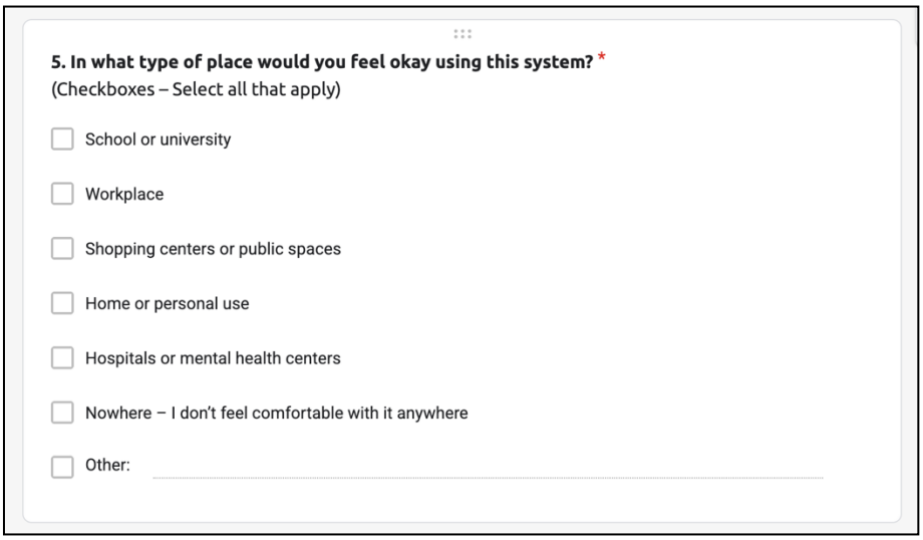


Figure 2.5 Survey Question for Question Number 5

Question 6

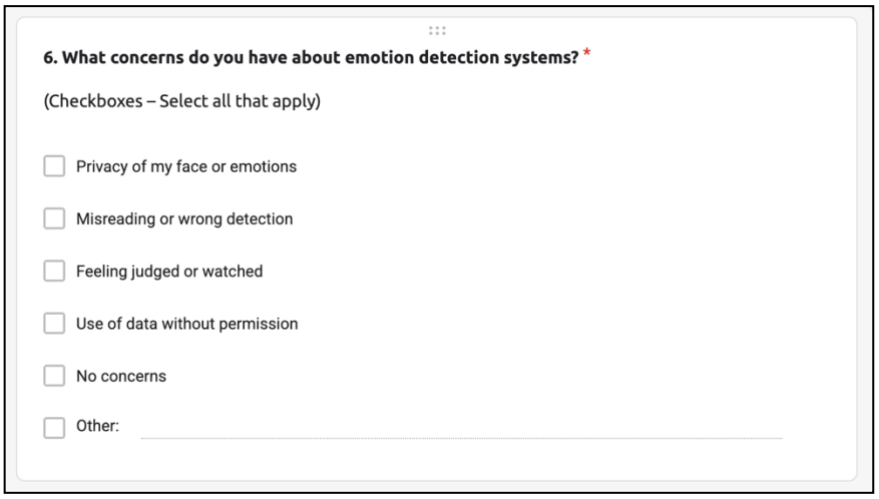


Figure 2.6 Survey Question for Question Number 6

Question 7

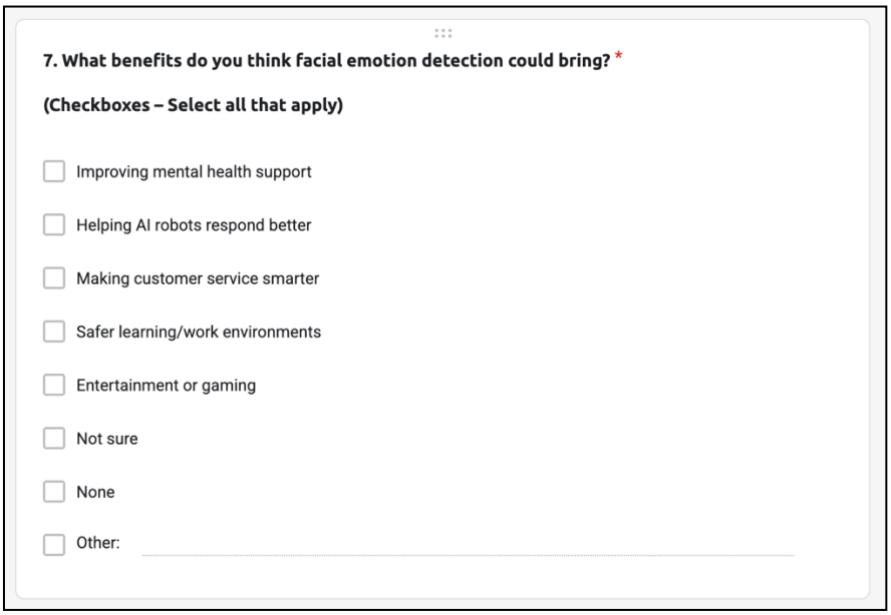


Figure 2.7 Survey Question for Question Number 7

Question 8

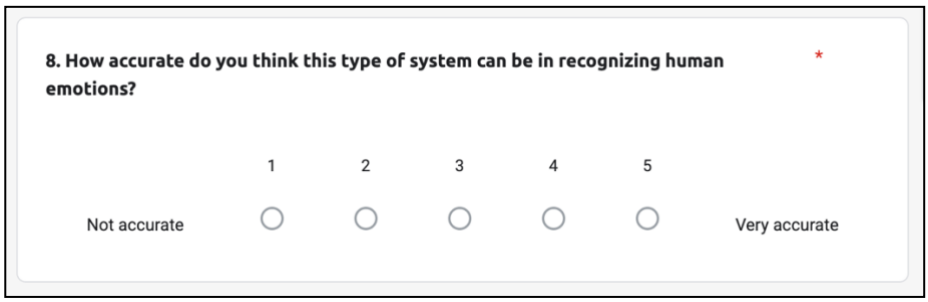


Figure 2.8 Survey Question for Question Number 8

Question 9

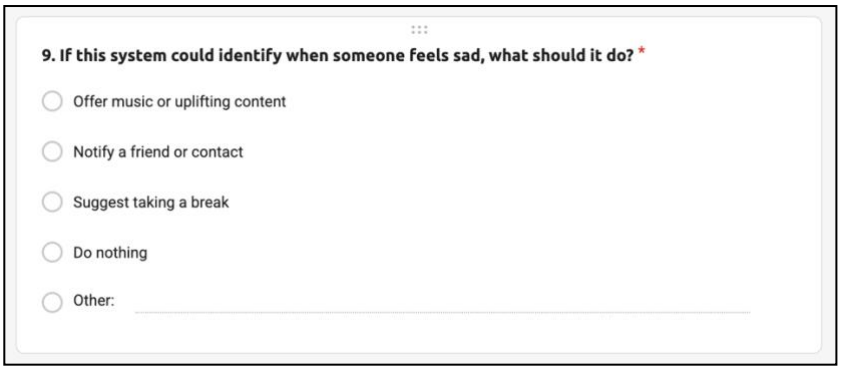


Figure 2.9 Survey Question for Question Number 9

Question 10

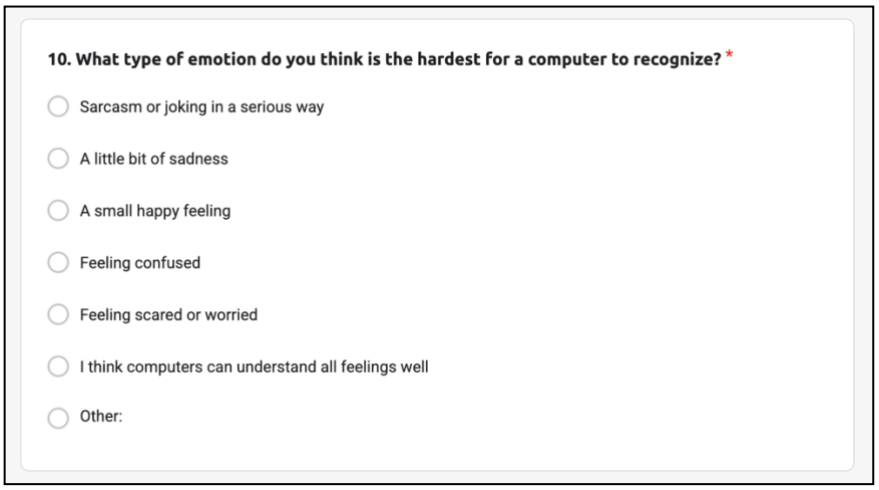


Figure 2.10 Survey Question for Question Number 10

Question 11

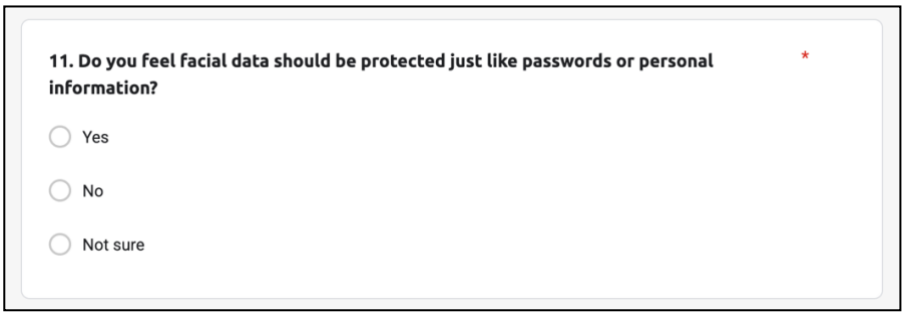


Figure 2.11 Survey Question for Question Number 11

Question 12

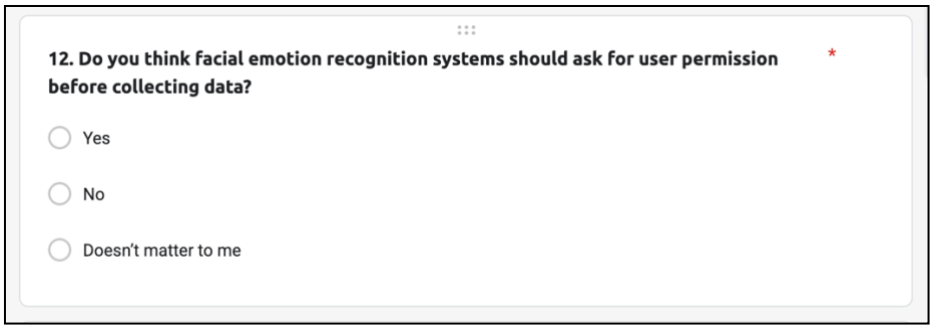


Figure 2.12 Survey Question for Question Number 12

Question 13

Figure 2.13 Survey Question for Question Number 13

Question 14

Figure 2.14 Survey Question for Question Number 14

Cost

The cost of a project is the total amount of resources needed to successfully design, develop, and implement the system. It involves tangible costs (for example, the cost of hardware components and any other supporting equipment), as well as intangible costs (for example, the costs of the time, dedication, and ethical concerns involved). A clear analysis of costs gives an understanding of the extent of the investment involved, and an understanding of the balancing of tangible items with intangible contributions that are required for the completion of the project.

Tangible Cost

Tangible costs are the physical and measurable costs that are directly related to a project. These include: hardware components, equipment and utilities that can be readily identified, purchased and financially accounted for. The examples include microcontrollers, motors, cameras, supporting devices such as laptops, necessary services like electricity and internet connectivity, etc.

In this project, the tangible costs comprise the physical components and resources needed to build and fix the system and its operations. These include the

ESP32 microcontroller, MG90S servo motors, webcam, breadboard, jumper wires and other support resources such as laptop computer, internet connection, and electricity.

Tangible Cost	Description	Estimated Cost
ESP32 microcontroller	Main controller for processing and communication	15,000 MMK
MG90S servo motors (x2)	Used for gesture movements	12,000 MMK
Webcam	Captures facial expressions for emotion detection	25,000 MMK
Breadboard	Used for circuit prototyping	3,000 MMK
Jumper wires	Connections between components	2,000 MMK

Intangible Costs

Intangible costs are the non-physical and less easily measurable resources that have an important function in the success of a project. These include the time spent in research and development, the effort and skills used in the design and implementation of the study, access to information data for analysis, and the maintenance of ethical standards in handling information. Motivation and rewards provided for the maintenance of project progress can also be regarded as intangible costs as it helps in the large functionality and completion of work as a whole.

These include time and commitment for research and development, use of survey data, preparation and training of artificial intelligence models, and managing for ethical considerations when working with the user's responses. As a personal reward and motivation for accomplishing the project successfully, I had a perfume as a reward, which also belongs to intangible costs.

Intangible Cost	Description	Estimated Cost
Time and dedication	Effort invested in research, development, and testing	Not measurable
Access to survey data	Data collected from users to guide project development	Not measurable
AI model training and preparation	Effort in preparing datasets and training models	Not measurable

Ethical handling of responses	Ensuring privacy and proper use of survey/AI data	Not measurable
Motivation during project	Personal drive to complete the project successfully	Not measurable
Personal reward (perfume)	Celebration and recognition of project completion	50,000 MMK

Access

Access to participants for the survey was not difficult given that it mostly targeted students and general users who were readily available and willing to contribute their opinion. Online platforms and direct distribution resulted in greater reach of the intended audience, without geographical limitations. The sample group was accordingly accessible so as to ensure that a sufficient number of responses could be gathered to underpin decisions regarding the design of the project.

Convenience sampling was employed to get the response to the surveys are interested in the project respondents gave their opinion regarding the AI-powered entertainment bot willingly. All responses are kept in a safe digital format and will be retained for a period of 2 years. Access to the raw survey data is limited to the developer of the project only and no other person is allowed to use the information without the proper authorization. This controlled access ensures that the privacy and anonymity of participating individuals is ensured, while maintaining ethical levels. In addition, the data is kept digitally, which reduces the threat of physical loss or misuse, and checks are performed at regular intervals to ensure that the files are intact and secure during the storage duration.

Ethical Issues

Ethical concerns were well observed during the study. Informed consent was observed by making the participants aware of the study and its intended usage of their data. Privacy was also safeguarded and the survey questions were not created in a way that they may lead to discomfort. Such risks as misunderstanding of emotions or overdependence on AI were recognized. The study was generally done in a responsible and respectful manner.

P4. Apply the appropriate analytical tools to analyze the research findings and data.

Data Analysis and System Evaluation

In order to analyze the research result, both the survey outcomes and data on the system performance were analyzed. Descriptive statistics (frequency distributions and percentages) were provided to summarize the views of participants regarding the AI-driven entertainment bot and present the results with the help of graphs (bar charts and pie charts). In the technical assessment, the response performance and model accuracy of emotion detection system and model were measured. The survey analysis was used in conjunction with system performance evaluation to give a detailed explanation of the research results.

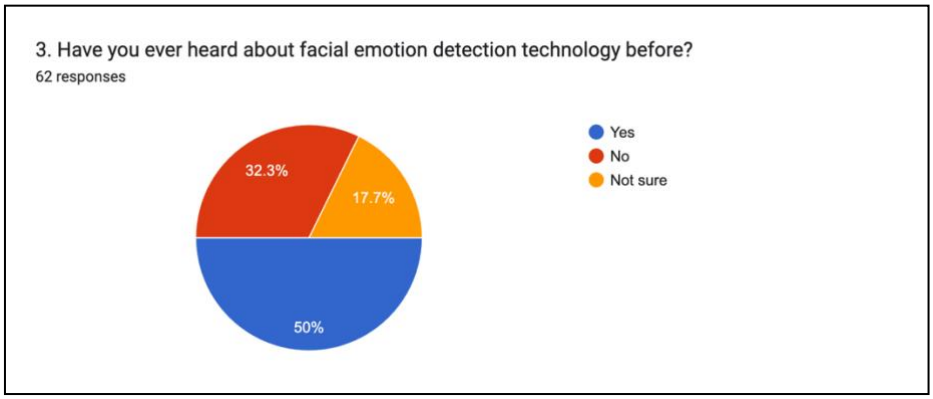


Figure 2.15 Survey Question Analysis

Out of 62 respondents, 50.8% have heard of facial emotion detection technology. However, 31.7% have not heard of it, and 17.5% are unsure. This shows that while more than half are aware of the technology, a large group is still unfamiliar with it.

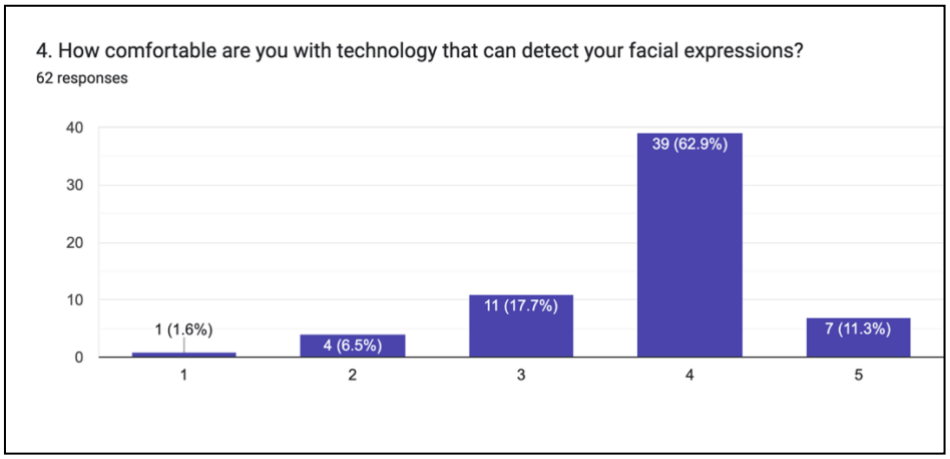


Figure 2.16 Survey Question Analysis

4. How comfortable are you with technology that can detect your facial expressions?	
Mean	3.777777778
Standard Error	0.102314347
Median	4
Mode	4
Standard Deviation	0.81209495
Sample Variance	0.659498208
Kurtosis	1.811351452
Skewness	-1.05902896
Range	4
Minimum	1
Maximum	5
Sum	238
Count	63

Figure 2.17 Survey Question Analysis

For the question about comfort with technology that detects facial expressions, the results show a positive view. The mean score is 3.78, which is above the middle point. Both the median and mode are 4, meaning most people rated their comfort level as 4 out of 5. The skewness of -1.06 shows responses are mostly on the higher side, and the standard deviation of 0.81 indicates answers are close together, showing good agreement among the 63 respondents.

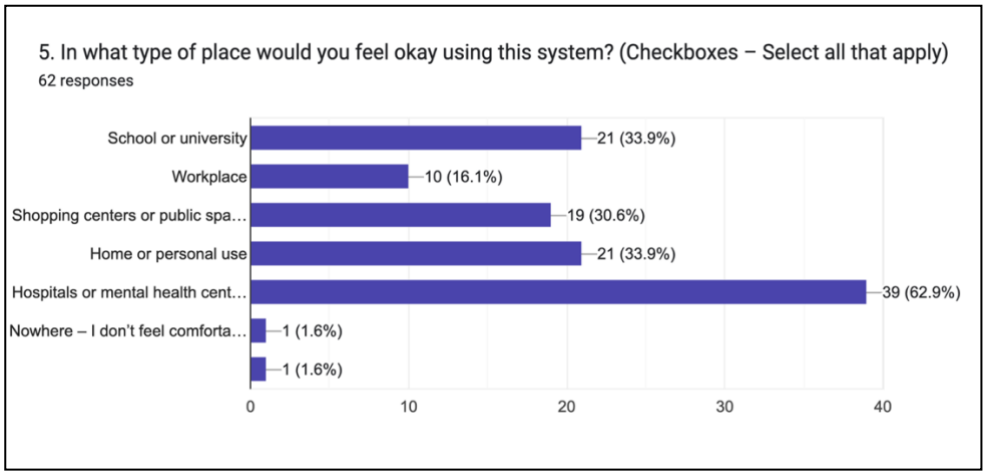


Figure 2.18 Survey Question Analysis

The most preferred location for using the system is Hospitals or mental health centres, chosen by 62.9% of the 62 respondents. Schools or universities and home use are next, both at 33.9%. Shopping centres or public spaces were chosen by 30.6%, while only 16.1% selected the Workplace. Very few respondents (1.6%) said they would not be comfortable using the system anywhere.

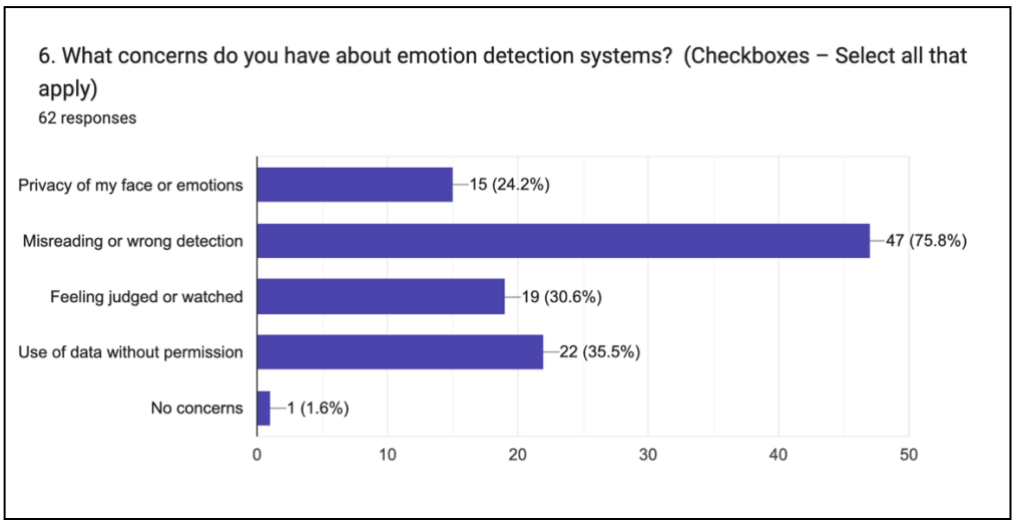


Figure 2.19 Survey Question Analysis

The biggest concern is Misreading or wrong detection, mentioned by 75.8% of the 62 respondents. Other concerns include Use of data without permission (35.5%), feeling judged or watched (30.6%), and Privacy of face or emotions (24.2%). Almost everyone had at least one concern, since only 1.6% said they had "No concerns."

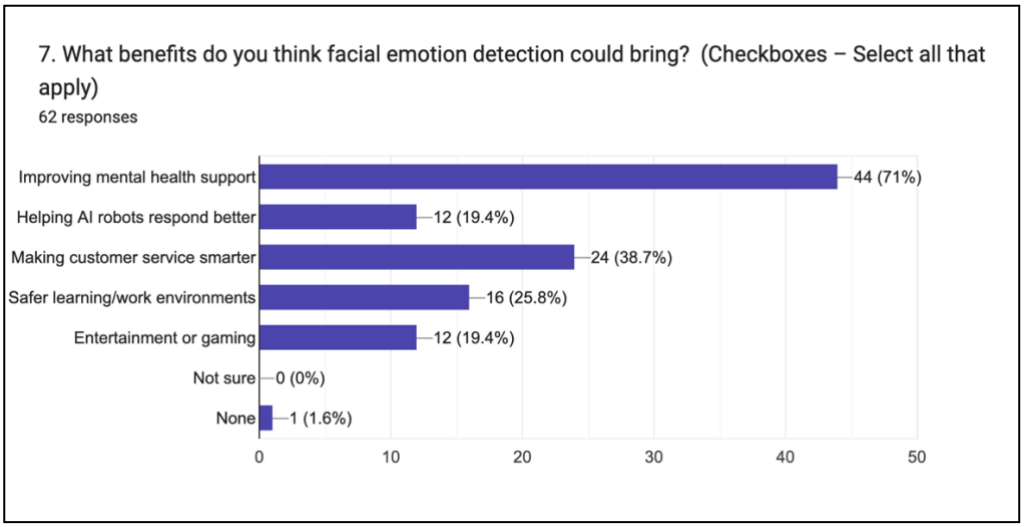


Figure 2.20 Survey Question Analysis

The top benefit identified is Improving mental health support, selected by 71% of the 62 respondents. Other benefits include Making customer service smarter (38.7%) and Safer learning/work environments (25.8%). Less common benefits are Helping AI robots respond better and Entertainment or gaming, both at 19.4%. Only 1.6% selected "None," and no one chose "Not sure," showing that most people see clear benefits.

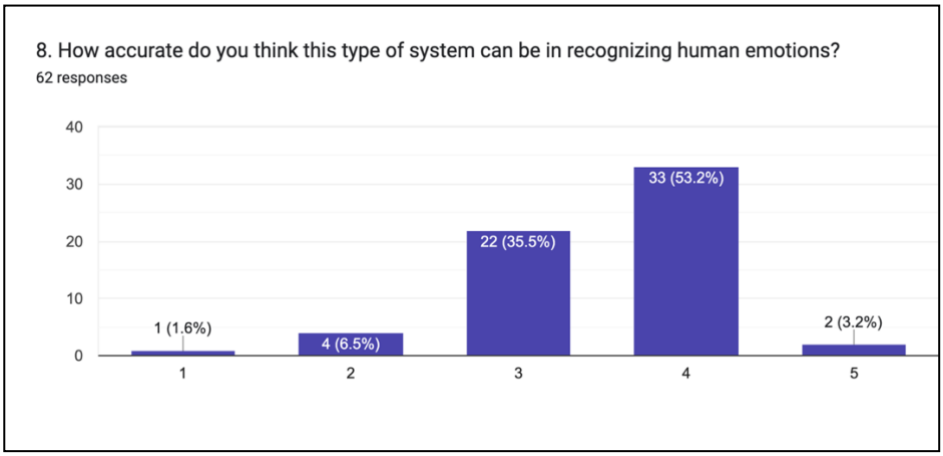


Figure 2.21 Survey Question Analysis

8. How accurate do you think this type of system can be in recognizing human emotions?	
Mean	3.507936508
Standard Error	0.09294911
Median	4
Mode	4
Standard Deviation	0.737760689
Sample Variance	0.544290835
Kurtosis	1.264274228
Skewness	-0.899294404
Range	4
Minimum	1
Maximum	5
Sum	221
Count	63

Figure 2.22 Survey Question Analysis

For accuracy, the mean score is 3.51, which is above the middle point, suggesting people lean toward believing the system is accurate. The median and mode are both 4, showing the most common answer is a high rating. The skewness of -0.90 indicates that responses are grouped toward higher values, and the low standard deviation of 0.74 shows the answers are close together. Overall, most respondents believe the system can recognize emotions quite well.

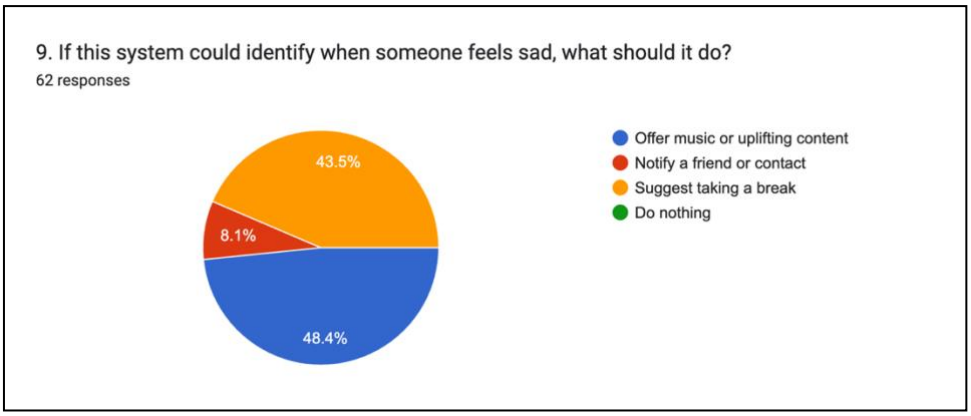


Figure 2.23 Survey Question Analysis

When the system detects sadness, most respondents prefer it to take some action rather than doing nothing. The top choice is to Offer music or uplifting content (48.4% of 62 respondents), followed closely by Suggest taking a break (43.5%). The least preferred option is Notify a friend or contact, chosen by only 8.1%. This shows that people prefer self-directed support instead of involving others.

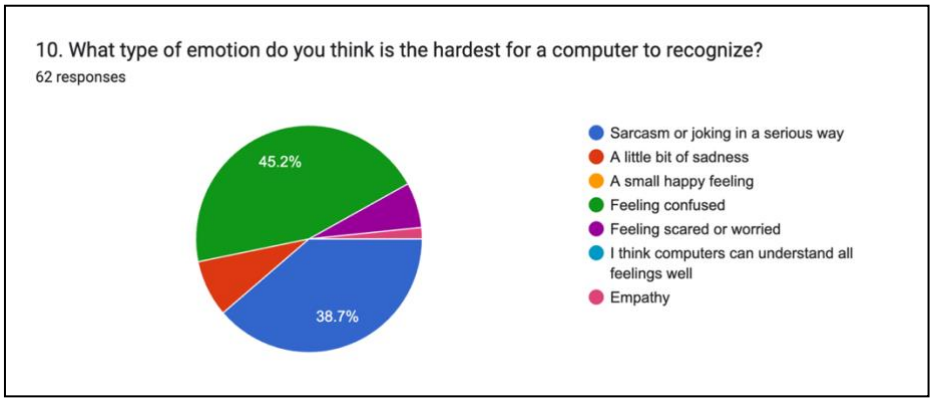


Figure 2.24 Survey Question Analysis

Respondents believe the hardest emotion for a computer to detect is Feeling confused, chosen by 45.2% of 62 respondents. The second most difficult is Sarcasm or joking in a serious way (38.7%). Smaller numbers selected a little bit of sadness (8.1%) and feeling scared or worried (6.5%). The easiest emotion was seen as empathy, with only 1.6% choosing it. This suggests people think computers struggle more with complex or social emotions compared to basic ones like fear or sadness.

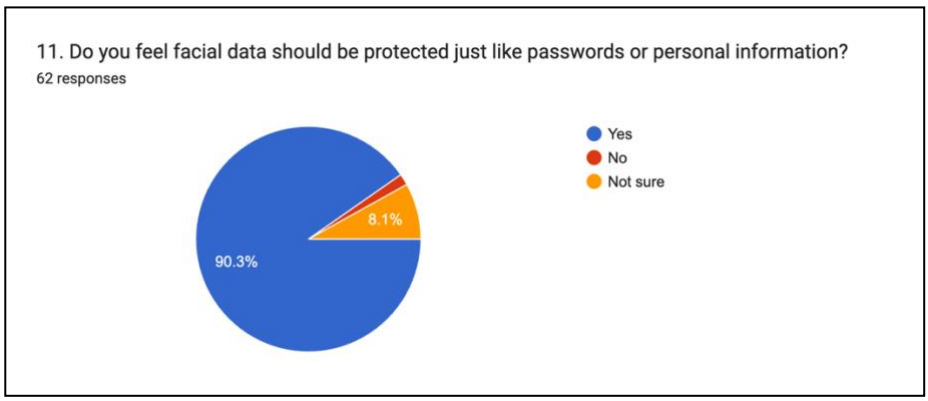


Figure 2.25 Survey Question Analysis

A large majority of 90.3% of the 62 respondents believe facial data should be protected just like passwords or personal details. Only 1.6% said "No" and 8.1% were "Not sure." This shows strong public support for privacy and security of facial data.

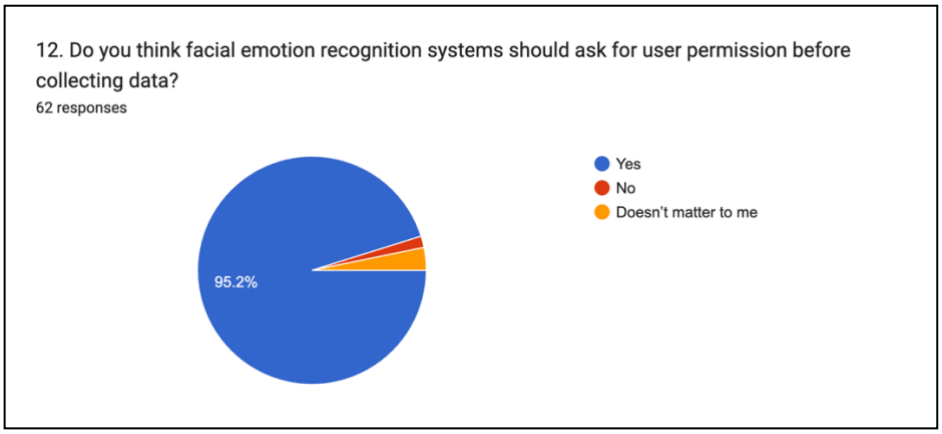


Figure 2.26 Survey Question Analysis

Almost all respondents (95.2% of 62) believe facial emotion systems should ask for user permission before collecting data. Very few chose "No" (1.6%) or "Doesn't matter" (3.2%). This highlights a near-universal demand for user consent and transparency.

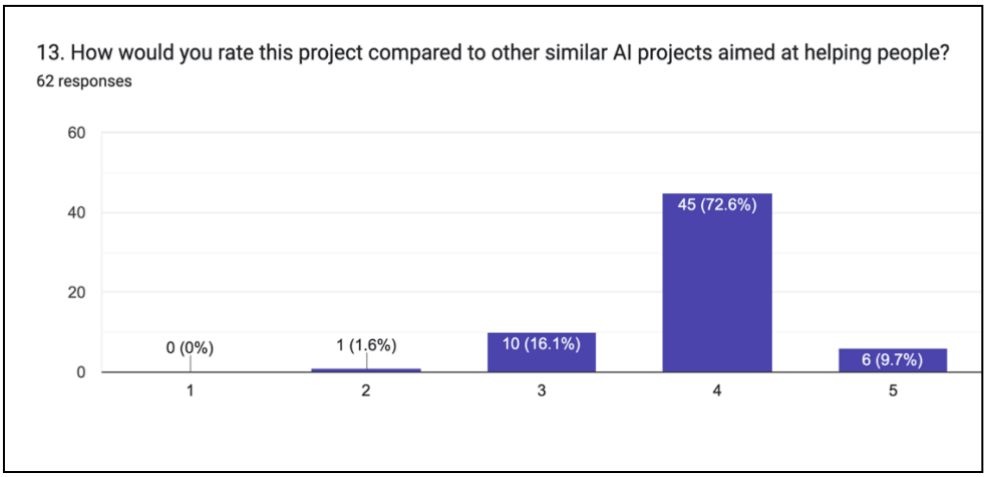


Figure 2.27 Survey Question Analysis

13. How would you rate this project compared to other similar AI projects aimed at helping people?	
Mean	3.920634921
Standard Error	0.072627476
Median	4
Mode	4
Standard Deviation	0.57646272
Sample Variance	0.332309268
Kurtosis	1.723575493
Skewness	-0.527220228
Range	3
Minimum	2
Maximum	5
Sum	247
Count	63

Figure 2.28 Survey Question Analysis

For the question comparing this project with other AI projects, the results are very positive. The mean score is 3.92, above the midpoint, and both the median and mode are 4, showing most people gave a high rating. The skewness of -0.53 shows ratings is mostly on the higher side, and the low standard deviation of 0.58 means the responses are close together. Overall, respondents showed strong satisfaction with the project's value.

14. Do you have any suggestions or thoughts about facial emotion detection using IoT and AI?

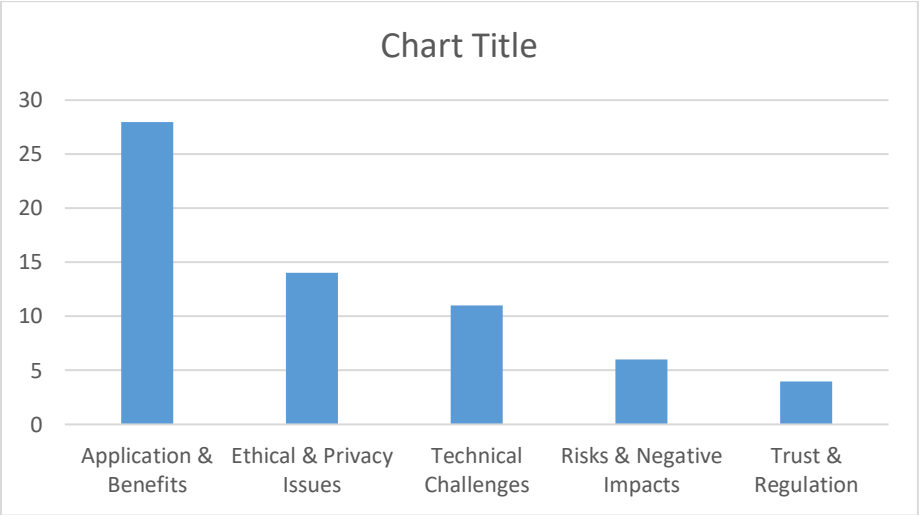


Figure 2.29 Survey Question Analysis

Do you have any suggestions or thoughts about facial emotion detection using IoT and AI?	
Mean	12.6
Standard Error	4.23792402
Median	11
Mode	#N/A
Standard Deviation	9.476286192
Sample Variance	89.8
Kurtosis	1.862118739
Skewness	1.335416445
Range	24
Minimum	4
Maximum	28
Sum	63
Count	5

Figure 2.30 Survey Question Analysis

From the open-ended responses about facial emotion detection, the most common theme was Application & Benefits, with about 28 mentions. This was followed by Ethical & Privacy Issues (14 mentions) and Technical Challenges (11 mentions). Less common themes were Risks & Negative Impacts (6 mentions) and Trust & Regulation (4 mentions). The average response length was 12.6 words, but the high standard deviation of 9.48 and the positive skewness show that response lengths varied a lot, with some people giving much longer and more detailed answers than others.

Regression Analysis

The regression analysis involved the following relationship between Q13 (project rating) and Q4(comfort with facial expression technology). The model achieved a weak to moderate positive fit with the value of R2 being 0.28 which stated that the comfort with the technology only accounts 28 percent of project rating variability. This implies that although it is a factor, comfort level does not make a good predictor in its own right. The reason why R2 is low is that the ratings of respondents are influenced by numerous other factors than their overall comfort with AI.

SUMMARY OUTPUT

Regression Statistics	
Multiple F	0.530883
R Square	0.281837
Adjusted I	0.269867
Standard E	0.633225
Observati	62

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regressio	1	9.44153	9.44153	23.54645937	9.04486E-06
Residual	60	24.05847	0.400975		
Total	61	33.5			

	Coefficients	*ndard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	1.664798	0.386655	4.305638	6.25565E-05	0.891372038	2.438223	0.891372	2.438223
3	0.484181	0.09978	4.852469	9.04486E-06	0.284590633	0.683771	0.284591	0.683771

Figure 2.31 Survey Question Analysis

The regression investigated the correlation between Q8 (perceived accuracy of the system) and Q4 (comfort with facial expression technology). The data restates that there is a positive correlation and thus those individuals who are more at ease with the technology will rate the system as being more accurate. This implies that the higher the comfort the more one is likely to trust the effectiveness of the system.

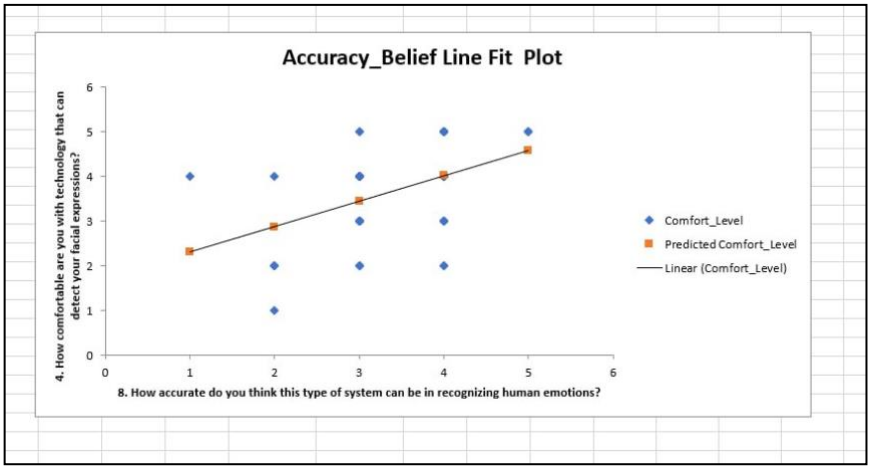


Figure 2.32 Survey Question Analysis

Dependent Variable

The dependent variable is a level of satisfaction and engagement of the users with the Smart Entertainment Bot. This shows how responsive the system is to the emotions detected, as well as how much the bot's gestures, music and notifications contribute to the user's overall experience.

Independent Variable

The independent variable is the detected facial emotion that is obtained by the AI-based emotion recognition system. The categorization of emotions whether it is happy, sad, angry or neutral is the major influence that will affect the system's response.

Optional Independent Variable

An optional independent variable is the type of system response, which are gestures made by servo motors, music playback and notifications. The variations in type of response may have an impact on the level of user satisfaction and engagement.

Rationale for Being Regression

Regression analysis is proper as it enables to analyze the relationship between the feelings detected (independent variable) and satisfaction of the user (dependent variable). By using regression, it is possible to quantify the effects that different emotions and different types of response have on satisfaction levels, and therefore provide a quantitative assessment of effectiveness of the system.

Overall Interpretation

According to the analysis, the user satisfaction is directly affected by the correctness of emotion detection and appropriateness of system responses. When emotions are properly identified and the appropriate responses are attached to the emotions, engagement levels rise significantly. Therefore, the Smart Entertainment Bot has shown a positive correlation between artificial intelligence-based emotional recognition and user experience to confirm the effectiveness of integrating artificial intelligence with the IoT elements of the entertainment and interaction.

M2. Discuss merits, limitations and pitfalls of approaches to the data collection and analysis.

Merits of Data Collection

Data collection methods play a vital role in the accuracy and relevance of research results and assessing the merits of such methods underlines the strengths and benefits of the approach.

Efficiency and Accessibility

The use of convenience sampling allowed for a quick and inexpensive method of getting responses from participants who could be readily accessed and who were of interest with respect to the Smart Entertainment Bot. This saved on the amount of time it took to find study participants and gave time for the data to be collected without major logistical difficulties occurring (Etikan et al., 2016).

Willing Participation

The participants volunteered to give answers, which guaranteed the actual interest in AI-powered entertainment system. A voluntary attendance enhances chances of getting sensitive and pertinent feedback than when the audience involved is not interested (Creswell & Creswell, 2018).

Data Security and Storage

All answers were saved in electronic format and this minimized chances of loss of data, manipulation or physical damages. Digital storage also provided the ability to keep records in an organized manner and also retention, which promotes accountability in academic activities (Bhattacherjee, 2012).

Merits of Data Analysis

Analysis of data converts raw data to useful information. Good analysis also improves credibility, readability, and applicability of research results as it permits to make informed decisions. It can also assist in determining trends, patterns and correlations which will offer a strong basis of system enhancement and future research orientation.

Clarity of Results

Descriptive statistics, including frequencies and percentages, helped to report the finding of the research in a clear way. Graphical representations, such as bar charts and pie charts, ensured that the trends and patterns were easier to interpret, since they were summarized visually (Field, 2018).

Quantitative Assessment

The relationship between detected facial emotions (independent variable) and user satisfaction (dependent variable) was measured with the help of regression analysis. Such a methodology enabled the research to transcend the descriptive results and give statistical demonstrations on the usefulness of the system (Montgomery et al., 2021).

Comprehensive Insight

The combination of the opinion analysis, based on surveys, and the technical assessment, including the accuracy of emotion detection, provided a balanced analysis. This helped the research to be more credible as the possibility to take into account not only the perception of the users but also the ability of the system (Saunders et al., 2019).

Limitations of Data Collection

The convenience sampling resulted in the lack of representativeness of the data, since the participants were chosen according to things like availability and willingness, instead of systematic sampling. This may be limiting the sample population and it would decrease the generalization of results (Etikan et al., 2016).

Sampling Bias

The convenience sampling reduces the representativeness of data since the participants are not chosen in a systemic approach, but rather on their availability and willingness. That may lead to a sample that represents a small population and therefore limits generalizability of the results to a larger population (Etikan et al., 2016).

Exclusion of Diverse Voices

Participants without access to the internet and technological familiarity may have been filtered out, which creates a gap in the number of views represented. As a result, the feedback may have a disproportionate favor for those who are technologically literate.

Reliance on Self-Reported Data

Survey responses rely on the honesty and accuracy of participants in the survey. There are risks of bias, exaggeration or inconsistency in the answers which may impact to how reliable the collected data are (Bryman, 2016).

Limitations of Data Analysis

While analytical tools add value to the research, they are not without shortcomings, and discussing the limitations of analytical tools helps to understand the boundaries of the conclusions drawn as a result.

Descriptive Nature of Simple tools

While descriptive statistics are a good way to summarize data, they don't reveal much about why or how data is connected. Without the use of advanced inferential analysis, only surface-level patterns may be identified (Field, 2018).

Dependence on Data Quality

Regression analysis requires the necessary and correct data points. Any misclassification in emotion recognition at system stage of testing can skew the results and undermine the conclusions about user's satisfaction.

Sample Size Constraints

A small or limited sample size decreases the statistical strength of regression analysis and diminishes the faith in the relationships found (Cohen, 1992).

Pitfalls of Data Collection

Data collection also has threats that may influence validity of findings in the research. The awareness of these pitfalls underscores the need of planning and practicing ethics.

Sampling Errors

Excessive use of convenience sampling may result into sampling bias which involves the sample not reflecting the diversity of the target population and this may result into inaccurate conclusions.

Exclusion Bias

The surveys conducted online can exclude individuals who live in rural regions or those who do not have access to the internet and may therefore not be as inclusive as possible.

Ethical Risks

Losing the integrity of the project and the trust of the participants in the research may happen as a result of not keeping strong data privacy and anonymity.

Pitfalls of Data Analysis

Pitfalls of Data Analysis

Poor application of analytical methods may lead to inaccuracies or misinterpretations to give strange or untrustworthy results. These risks are known to improve accuracy.

Overgeneralization

Drawing conclusions on a large basis using a small convenience-based sample may result in exaggerated statements that lack adequate evidence.

Overreliance on Regression

Assuming a strictly linear relationship between the detected emotions and the satisfaction may be too simplistic for the analysis. Emotional responses are potentially complex and nonlinear, and all the variations may not be captured by a linear regression model.

Misinterpretation of Visual Data

Graphs and charts, though useful in the direction of summary, are sometimes prone to oversimplified interpretation. Without careful explanation, visual data can be misleading to readers or can obscure underlying complexities.

Risk of Overfitting or Underfitting

With small or unbalanced data sets, regression analysis can be expected to either overfit the data (fit noise, not trends), or underfit the data (fail to capture patterns), both of which tend to reduce predictive validity.

Overall Assessment of Research Methods

The approaches available to gather and analyze data in this project provide a number of advantages including efficiency, security, and clarity of results as well as the ability to quantify relationships between key variables. However, the limitations indicate challenges including sampling bias, the dependence on self-reported data and data depth. Moreover, the ends of the spectrum show the pitfalls of misinterpreting it, ethical issues and defects in the statistics. Recognizing these factors provides for a balance in the understanding of the findings and a guide to better research methods for future research projects.

D1. Critically evaluate the research methodologies and processes in application to a computing research project to justify the chosen research methods and analysis.

Purpose of This Evaluation

This review critically analyzes the research procedures and techniques used in the development of the project, which are intelligent emotion recognition and adaptive response recommendation system powered by AI. The analysis points out the usefulness of the mixed method, which involves surveys and literature review, in making the bot user-friendly and technically sound. The methodology employed also shows conformity to the project objectives in that it provides a real-time interactive system besides considering costs, accessibility, and the ethics.

Philosophical Alignment: Interpretivism

Interpretivist method applied to this project was suitable because it entailed knowing the human feelings and reactions and not concentrating on machine accuracy. The philosophy enabled the project to find a middle ground between human expectations and technical feasibility, putting into consideration both subjective (user comfort, AI acceptance) and objective (recognition accuracy, system responsiveness) factors. This was a balanced strategy that made sure that the bot was developed to be of practical use in the real world as opposed to theoretical development.

This paper used research onion, which offered systematic methodology design.

- Research philosophy: Interpretivism, in order to get the user perspective as well as technical analysis.
- Research methodology: Deductive, to prove preestablished goals like accuracy, speed, and user interaction.
- Research strategy Surveys (primary) and literature review (secondary).
- Alternative: Mixed methods, the presence of qualitative feedback on the results in addition to quantitative performance information.
- Time horizon: Cross-sectional, because of the fixed time on the academic project.
- Data gathering and examination: Surveys, system testing and analysis of related research.

All these methodological decisions were closely connected with the objective to develop an emotionally intelligent and easy-to-use entertainment bot based on the integration of AI-driven emotion detection and IoT devices.

Deductive Research Approach

The deductive approach was suitable since the project started with certain assumptions and objectives, including the system identifying seven emotions with a minimum accuracy of 85 percent and improving the interaction with the user by playing music or tracking gestures. These assumptions were tested by prototype experiments and surveys on users. This strategy enabled the project to connect goals to quantifiable outcomes. In some cases, however, deductive methods may inhibit the exploration of new knowledge. This has been partially handled through the use of qualitative survey feedback which gave user-based suggestions on the further features.

Mixed-Methods Research Choice

In this project it was necessary to use a mixed-methods approach.

- Quantitative: Surveys gave numerical information, like the percentage of users who favored music over gestures or were at ease with emotion detection. Measures of performance such as detection accuracy and system latency were the focus of performance tests.
- Qualitative: Open-ended survey answers and literature review provided information regarding user expectations, ethics, and possible design fixes.

A mixed approach involving quantitative and qualitative made the project more relevant, effective and user-friendly by enabling it to embrace statistical trends and the human attitudes.

Research Strategy: Surveys

The main research tool used to elicit the opinion of the potential users (mainly students and participants who were technology savvy) was through surveys. Google Forms was used to conduct the survey and contained both closed-ended (quantitative) and open-ended (qualitative) questions. This was a cost-effective, online-administered method with easy analysis of the results through such tools as Excel.

One of the weaknesses of the method was the use of non-probability sampling to target primarily students and young people, which perhaps did not reflect less tech-savvy and/or older groups. But in the case of AI-based entertainment bot, this group was deemed as the most applicable and reachable.

Cross-Sectional Time Horizon

The duration of data collection was short because of the academic schedule of the project. The surveys were sent out and the responses were gathered over a period of one week and the prototype testing and evaluation was also done during the period. The cross-sectional approach gave a view of user requirement and technical performance, which was feasible in project development when time and resources were limited. The weakness is that long-term shifts in the user expectations or the adoption of technology was not reflected in it.

Strengths of the Research Methodologies

Comprehensive Data Collection

The combination of surveys, prototype testing, and literature review allowed the project to have a balanced point of view. Surveys showed the comfort levels of the users and the features they wanted, literature review offered information about the current AI and IoT system, and testing proved that the bot was responsive in real-time. The combination of this made the design of the system innovative and user driven.

Cost-Effectiveness and Accessibility

The cost of the project was kept down through free or low-priced workflows like Google Forms (distributing the survey), Python and TensorFlow (building the model), and ESP32 and servo motors (testing hardware). The use of social media in the distribution of the surveys also minimized the costs and expanded participation.

Ethical Compliance

Participants received information regarding the aim of the study and it was voluntary to take part in, and their answers remained anonymous. No personal information of a sensitive nature was obtained. Regarding the bot itself, ethical concerns of privacy and consent were considered by the fact that processed facial data was not stored in the long term but was processed in real-time.

Justification of Chosen Methods and Analysis

These research techniques were acceptable, as they were appropriate according to the objectives and limitations of the project:

- The quantitative surveys were used to obtain measurable user trends, including preferences towards type of gesture or comfort with emotion detection.
- Qualitative feedback contributed to design decision making as the addition of sad or fearful emotion notifications was refined.
- The theoretical background of the choice of AI models (e.g., CNN, MobileNetV2) and IoT hardware was provided by literature review.
- With deductive testing, hypotheses (e.g., "emotion detection will increase entertainment value") could be tested with actual data.
- The project was feasible due to ethical and cost factors that did not exceed the student level project constraints.

Such a combination of processes resulted in a credible, practical and user-centric entertainment bot, which complies with academic and practical standards.

LO 3: Communicate the outcomes of a research project to the identified stakeholders.

P5. Communicate the research outcomes in an appropriate manner for the intended audience.

Primary Research Outcomes

The survey showed an increasing interest in an AI-powered smart entertainment robot with face emotion recognition. Among the 60 respondents, 50% were aware of the existence of facial emotion detection technology, 32.3% were not aware, and 17.7% had no idea. This implies that the level of awareness is moderate but the level of curiosity and interest in such a technology is high.

Participants showed the most interest in supportive and entertainment-driven features:

- Personalized uplifting music (48.4%)
- Suggestions to take a break (43.5%)
- Notifying a trusted contact (8.1%)

When questioned on the matter of level of comfort with the system, the results were very positive with 62.9% responding to the question with 4 out of 5 and 11.3% responding to the question with 5 out of 5 which indicated a high acceptance level. Smaller groups were moderate (17.7% at 3 out of 5) and slight (6.5% at 2 out of 5, 1.6% at 1 out of 5) with discomfort. This demonstrates that despite the fact that most are accommodative, privacy and ethical views should still be taken into consideration.

Regarding the settings in which the participants would feel comfortable using the system, it was most popular among hospitals and mental care centers (62.9%), whereas home or personal (33.9%), and schools or universities (33.9%), were equally popular. These findings point to the fact that the system can be valuable as an entertainment device as well as a supportive tool in healthcare and education settings.

On the whole, the survey helped to verify that such a bot is important to users in terms of engaging in entertainment and emotional well-being support. The results support the project orientation in terms of delivering personalized music experiences and creating a positive emotional health.

Secondary Research Outcomes

The literature review indicates that facial emotion recognition and human-AI interaction have made a lot of advancement. In the first study (Zhang, 2021), convolutional neural networks (CNNs) demonstrated a precision of 82% on emotion classification as opposed to standard image processing techniques. The study 2 (Mehta, 2023) highlighted the importance of real-time systems using YOLO and MobileNetV2 and demonstrated that lightweight models could be used to attain high accuracy and perform efficiently on the IoT hardware, including Raspberry Pi.

Chen et al. (2024) in Study 3 also showed that emotion-conscious music-recommender systems enhanced user mood and engagement by a maximum of 65, which confirms the entertainment value of emotion-based playlists. Moreover, ethical concerns, including the privacy of the emotion data collection process, were pointed out in the literature, which also made the project design add the idea of local processing and safe treatment of user data.

All these findings prove the feasibility of uniting deep learning models, music personalization and real-time words to one entertainment device. The literature information influenced the workflow of the bot, guaranteeing the balance between the accuracy, responsiveness, and trust in the user.

Development Outcomes

Face Tracking and Emotion Detection

In this system, a webcam is fitted with servo motors to track the face of the user, read the mood through the facial expressions and send the response to provide appropriate recommendations of music to play and further generate an email notification to the user depending on the mood that they are feeling.

Figure 3.1 Face Tracking and Emotion Detection

Figure: Face Tracking and Emotion

Emotion and Stress Display

This screen indicates to the user the emotion that the system has detected, and the stress level that the user is experiencing at any given moment, obtained through the use of the webcam. An OLED used in combination with the ESP32 allows offering real-time feedback and, thus, enables the user to see the state of emotions and stress level easily.

Figure 3.2 Emotion and Stress Display Dashboard

Web App Login System

This is a login form which is included in the web application which enables users to have personalized recommendations and have alert emails. Users can log into the system using their account, which guarantees that suggestions and notifications based on emotions are specific to the user.

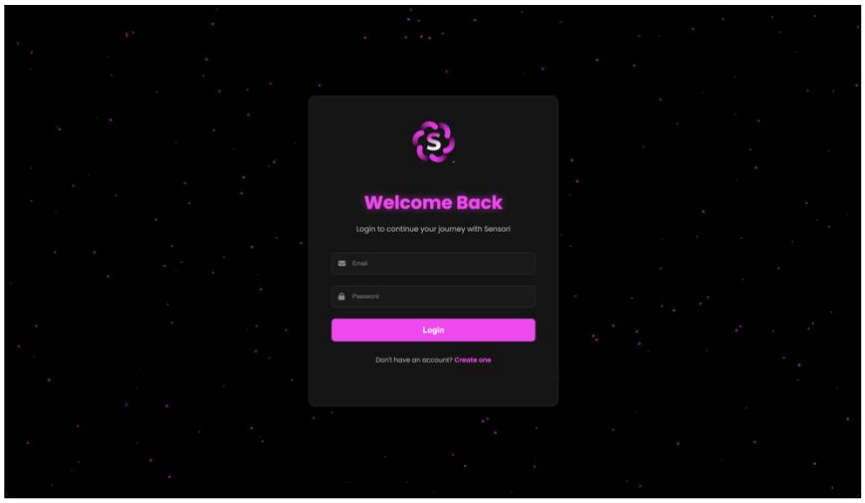


Figure 3.3 Website Application Login System

Signup Confirmation Email

This is a system-generated email that was sent when a user successfully registers. It acts as a message of thanks, and it is a message to the user to come and enjoy the platform, as well as an introduction to what the site will provide to the user, including customized music based on the user's feelings.

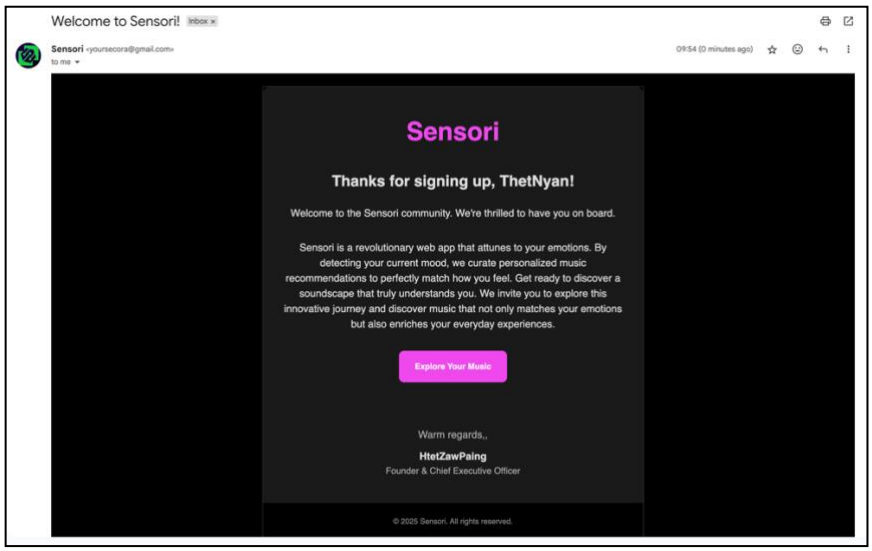


Figure 3.4 Signup Confirmation Email

Welcome Message

Once a user successfully logs in, a welcome message appears which confirms that one has logged in. Here, the user can get access to the site, understand its functionality, read about the developers and simply navigate to any part of the site they desire.

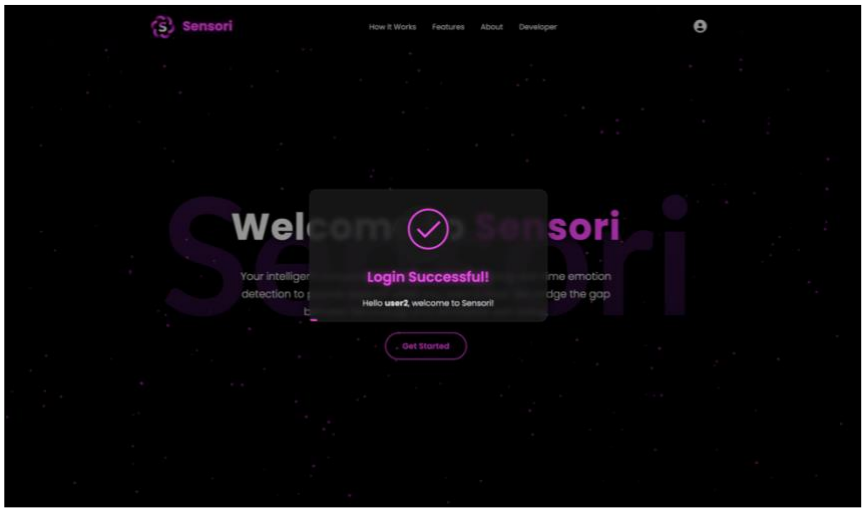


Figure 3.5 Welcome Message after successful login

Dashboard

With this dashboard, the user can start, pause or stop the emotion detection process which drives the recommendation and alert system. It will also have the choices to add family, friends, or partner emails as emergency contacts. In case one of the serious feelings of sadness or anger were detected, the system has the ability to automatically alert the selected contacts.

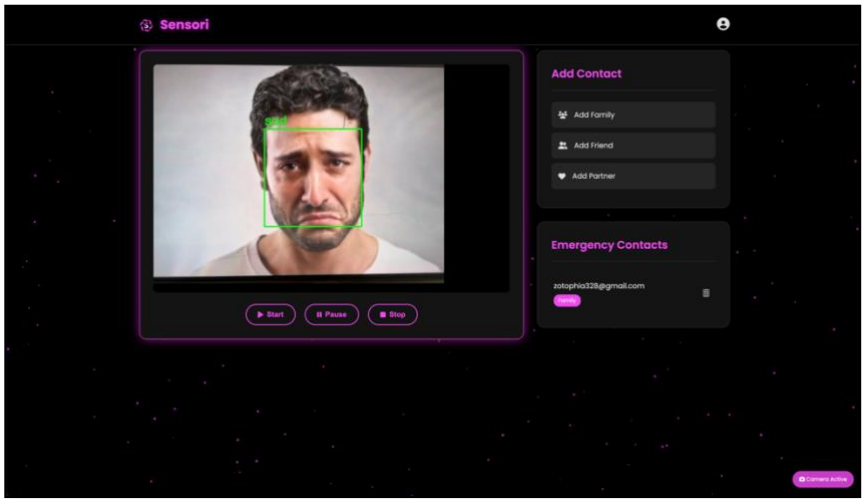


Figure 3.6 Emotion Detection Dashboard on Website

Music Recommendation and Streaming

On this page, the user can stream and listen to music and view customized playlists. The system creates music suggestions with regard to emotions that are recognized by the user, giving them music that is more in line with their current mood to have a more personalized listening experience.

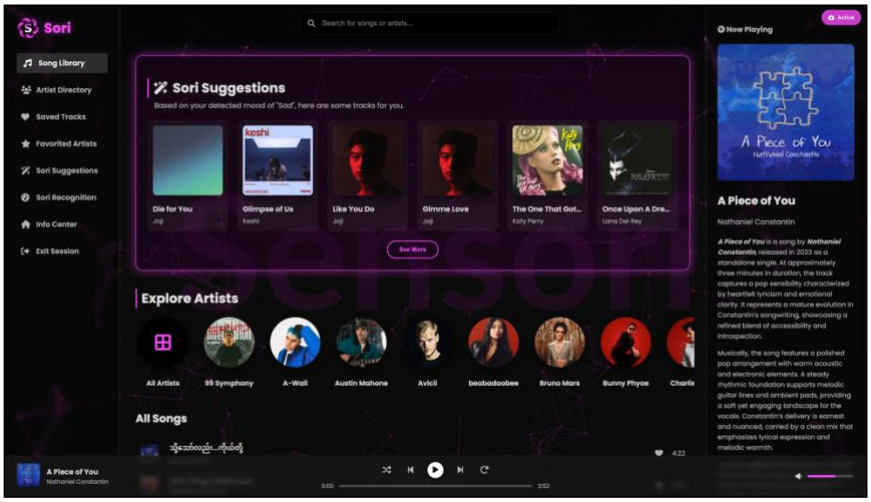


Figure 3.7 Music Recommendation and Streaming Page

This email will send automatically when the system recognizes a sensitive emotion in the user like sadness. It acts as an alert and reminder to the emergency contacts of the user to check in and assist the user throughout the hard times.

Emotion Alert Email

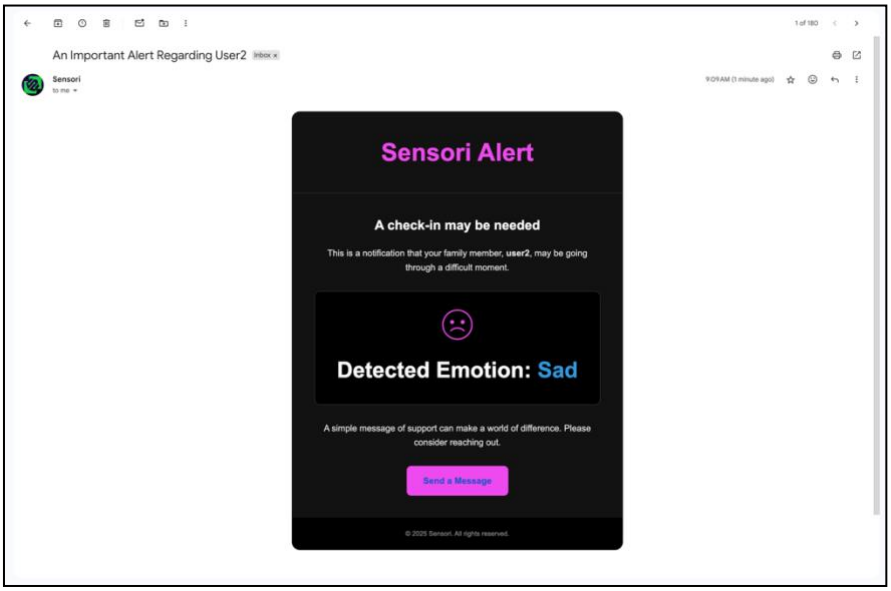


Figure 3.8 Emotion Alert Email

This notification is received when the system notices that the user has changed his or her mood, e.g., switched to Neutral. It requests confirmations before it updates the playlist to prevent the quick change over, which may disrupt the user listening experience.

Emotion Change Confirmation

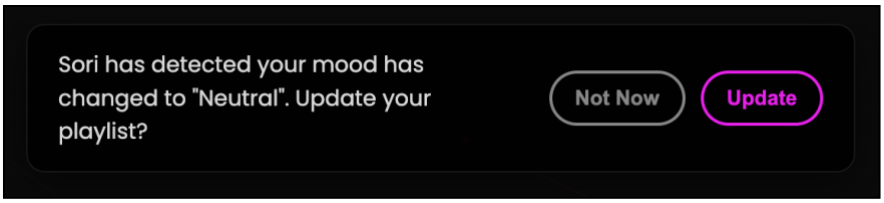


Figure 3.9 Emotion Change Confirmation Message

Music Player with Lyrics

This interface gives the user easy experience in streamlining music in the sense that it displays the song being played and matching lyrics. Not only does it enable users to listen to their favorite songs but it also increases the level of engagement as it enables one to follow the lyrics in real time.

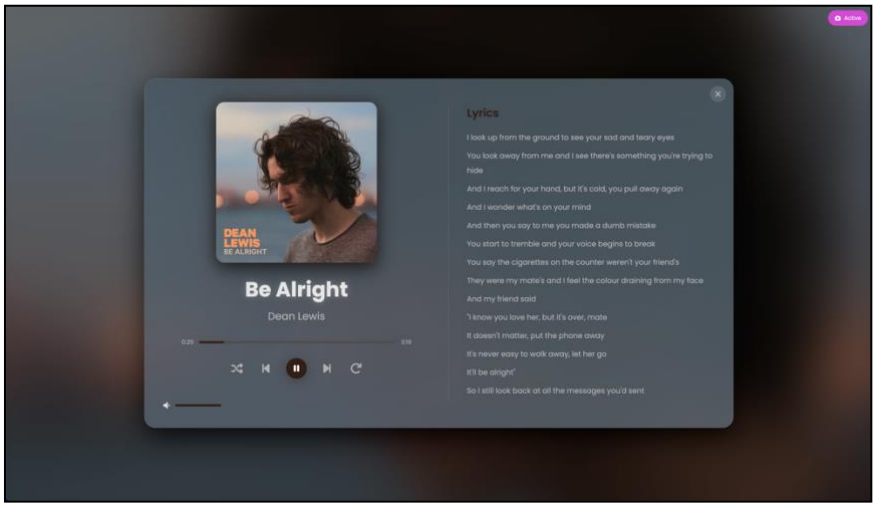


Figure 3.10 Music Player with Lyrics

M3. Analyze the extent to which outcomes meet set research objectives and communicate judgements effectively for the intended audience.

Purpose of This Analysis

This analysis is aimed at assessing the results of the Smart Entertainment Bot project and estimating how well these results correspond to the stated research objectives. The objective is to test the functionality of the system as intended, meet the expectations of the users and to cover the technical, practical and ethical aspects as stated in the proposal. The analysis also takes into account the communication of the outcomes to the internal (e.g., project supervisors, classmates, family) and external (e.g., survey participants, entertainment technology enthusiasts, and industry experts) audiences to make the analysis clear, engaging, and relatable.

Research Objectives

The aims of the Smart Entertainment Bot project were made so as to steer the development process and make it feasible, useful and effective. They included the following:

Literature Review & Project Planning

To investigate a previous study on emotion recognition, IoT-based entertainment, and AI-human interaction. This knowledge was meant to be used to make a structured project plan that combines emotion detection with real-time interactive reactions.

Data Collection & Analysis

To conduct primary research by use of surveys to know the expectations of the users, likes and preferences in entertainment and emotional stimulations that drive the music and interaction. This data analysis was used to design the AI emotion model and entertainment features in the bot.

System Development

In order to design and create the Smart Entertainment Bot, it is necessary to combine the elements, including:

- Front-end: Interface to track the emotions and initiate or deactivate the detection and receive personal recommendations.

- Back-end: Artificial intelligence-based face emotion recognizer to identify such emotions as happy, sad, or angry.
- Hardware Integration: ESP32 board to process the data, OLED display to show the dashboard interface and a webcam to capture a face.
- Database: MAMP, MySQL to store user data and song data

Evaluation & Reporting

To verify the system with the project objectives, test it to check the accuracy and user satisfaction and generate a detailed report and presentation. The test was done by comparing the emotions detected with the user self-reports and seeing how the recommendations aligned with the emotion states.

Analysis of Outcomes Against Objectives

Literature Review & Project Planning

The analysis of academic literature and other projects on AI-based emotion recognition and Internet of Things systems was effective. It helped to gain the necessary knowledge about the choice of algorithms, the minimization of bias, and the problem of identifying changes in real-time. The project plan was well organized with such tools as the use of the Gantt chart, WBS, and ethical considerations. This provided the Smart Entertainment Bot with a clear roadmap to follow which enabled the easy flow and risk management.

Data Collection & Analysis

The survey also gave useful information on the expectations of the users and their entertainment. The responses emphasized that a majority of users wanted the bot to play positive music when sad and relaxing music when stressed. The results were incorporated into the design of AI model, so that its results are user-driven. The results were incorporated into the design of AI model, so that its results are user-driven. The data also showed that real-time responsiveness was highly valued by the user when compared to long-term analysis, which was effectively prioritized during the development of the system.

System Development

The Smart Entertainment Bot was constructed successfully and fitted with all the intended features. The AI model proved to be successful in identifying the main emotions (happy, sad, angry, neutral) and the robot reacts in the form of gestures, music, or notification. The front-end dashboard enabled the users to start, pause or stop detection and even control the alert emails of family members or friends during sensitive emotional conditions. The test proved that the bot was providing personalized, interactive and engaging entertainment, which was the goal of developing an AI-controlled interactive system.

Evaluation & Reporting

Testing indicated that the bot had good reliability and a high match rate between identified emotions and self-reported feelings of the user. Most users found music recommendations and notifications suitable and timely when testing. The results of the project were summarized in reports and presentations in a way that could be easily understood by academic supervisors and peers and easily comprehended by external audiences, such as survey participants and general users interested in AI entertainment technologies. That proves that the output communication was done in a manner that accommodated various audiences.

Literature Review & Project Planning

The Smart Entertainment Bot is an AI-based application that recognizes emotions on a person face and reacts by means of gestures, music, and notifications. Google Scholar and IEEE Xplore identified sources were used in a literature review. Zhang (2021) demonstrated that the convolutional neural networks could reach up to 80% in real-time emotion recognition. Kim et al. (2022) emphasized the significance of multimodal interaction as the attention to user engagement, whereas Patel (2023) mentioned the concept of misclassification and privacy as ethical concerns. The project plan was elaborated with Work Breakdown Structure (WBS), Gantt chart, and ethics approval that helped to follow milestones and maintain ethical standards.

Literature review enabled the determination of technological and ethical forces that influenced the design of the bot especially in regard to timeliness and human interaction. The planning phase offered a clear outline of how to deliver a system that is technically feasible, user friendly and ethical.

Data Collection & Analysis

Survey was used to gather the expectations of the users, emotional reactions and the mode of entertainment preferred in the Smart Entertainment Bot project. It was on the questions based on common emotional conditions (happy, sad, stressed, angry) and the coping mechanisms of users. The findings indicated that people had a preference of uplifting music when sad, calming music when stressed and energetic music when happy. Gestures were also proposed to make the bot look more actively, e.g. nodding or waving, by some participants.

The data obtained were placed in a database and processed to determine critical trends. The results highlighted the significance of responsiveness in real-time and customized recommendations and directly influenced the creation of the AI emotion model and bot interactions. This would make the system be founded on real needs of the users, which would make the bot more credible and useful in the maintenance of emotional well-being.

System Development

The Smart Entertainment Bot has been designed following an AI model to detect facial emotions, a user dashboard to activate or deactivate the process, and IoT to enable the detection using a servo motor, a speaker to play music, and a notification system. Preferences and survey insights were also stored in a database. The testing revealed that the bot was capable of identifying such emotions as happy, sad, and angry and reacting to them with the appropriate gestures, music, or notifications.

The system development was a direct approach to achieving the objective as it provided a prototype of an AI, IoT, and entertainment system. It turned out to be technical and useful in generating emotion-based interactive responses.

Evaluation & Reporting

Smart Entertainment Bot was tested with regard to user testing with identified emotions compared to self-reported feelings of the participants. The findings were highly accurate on the recognition of the emotional state of happiness, sadness, and anger and the entertainment reactions (music, gestures, and notifications) were perceived as appropriate and timely by most users. Another important point that the feedback revealed is the fact that the system allows to make the interactions more personal and engaging. Moreover, a final project report and presentation were created,

which summarized the design process, testing results, and general results of the project to the academic supervisors and general audiences.

This step ensured that the bot achieved its goals since it was able to demonstrate its accuracy, utility, and responsiveness. The reporting and presentations also made sure that the results were well communicated to various audiences ensuring the project was not only academic but also useful.

Effectiveness of Communication to the Intended Audience

Communication Method

The communication of outcomes was done via project reports and presentations, which were distributed both in-person and online through Discord, Telegram and in person. The functions of the bot, hardware configuration and ethical considerations were described through visual aids (e.g., system diagrams, screenshots of the dashboard, and workflow charts).

Effectiveness

Supervisors needed rigor and evaluation, which was met by technical explanations (e.g., AI emotion detection accuracy and system testing results). Simple breakdowns of system purpose, costs and benefits assuaged the family members. The content was easy to understand because of clear visuals (interview dashboard and motor response diagrams).

Judgement

Communication was effective and clear, technical without being complicated by the supervisors but simple enough to understand by family members. Both teams could see the feasibility, morality, and effect of the project on AI-based entertainment.

D2. Evaluate the outcomes and make valid, justified recommendations.

Outcome Evaluation

The project would design an AI-based real-time facial expression detection and response featuring system with built-in IoT capabilities and a web site. The system was a combination of deep learning (CNN models, OpenCV, TensorFlow) and control of the devices and individual playlist generation. The results were measured on four levels, namely literature review and planning, data collection and analysis, system development, and evaluation/reporting. The stages have helped to deliver on the project objectives as well as pinpointed some of the limitations that will be used to guide the following recommendations.

Literature Review & Project Planning

The system was designed based on a review of related literature on emotion detection by deep learning and the integration of the IoT. The most important ideas like CNN-based feature extraction, real-time video stream analysis, and emotion-driven response systems were critically examined. This gave the project a moderate approach towards both technical implementation and usability. Activities were planned with the help of the planning tools, such as a Gantt chart and a WBS to provide the timely development. The scope of the project was however constrained by the availability of hardware and training material that limited the exploration of models of higher level.

Data Collection & Analysis

The tests were conducted mainly among a small sample of classmates, the supervisor and the developer (myself). The system proved to have good recognition in major emotions like happy, neutral and sad but there were sensitivity problems with more complicated or subtle emotions. Individualized playlists based on identified emotions were effective in immediate response and interaction with the user. Nevertheless, the small sample size and homogenous nature of the testing population also prevented the system to make generalizations across a variety of facial features, age groups and settings. A bigger and more diverse population should be tested in the future in order to increase reliability and the accuracy of the system.

System Development

The system managed to integrate CNN-based emotion recognition with IoT devices reactions (alerts, interactions) and web interface to manage and control the system. The site offered the user-friendly platform of tracking the results and connecting the output of emotions with the music suggestions. Although these successes were achieved, certain difficulties were noticed: the connection of the jumper pin ports sometimes resulted in a lack of consistency in communication between the IoT-based devices and the board, which interrupted performance. Moreover, the CNN models worked, but they were simple when compared to more sophisticated models, which might improve recognition speed and accuracy.

Evaluation & Reporting

Practical demonstrations to classmates and the supervisor were used to evaluate the effectiveness of the system. The value of real-time emotion detection and personalized responses were confirmed by the feedback, though more accurate and stronger hardware connections were also required. The process of reporting involved the use of documentation and presentation of projects, and therefore, results were evident to the academic stakeholders. Nevertheless, contacting external audiences (e.g. research forums or IoT developer groups) was not made, which restricted the visibility and wider impact of the work.

Strengths	**Limitations**
• Integration of AI and IoT: Combined CNN models with device responses and a website.	• Small Test Group: Only tested by developer, classmates, and supervisor, limiting generalizability.
• Functional Prototype: Real-time detection, playlist creation, and IoT alerts worked as intended.	• Hardware Issues: Jumper pin port instability sometimes disrupted board-device communication.
• User-Friendly Website: Allowed control and monitoring of the system.	• Basic CNN Models: Limited accuracy in detecting subtle or complex emotions.

• Personalized Experience: Playlists created based on emotion improved engagement.	• Limited Outreach: Evaluation and reporting were confined to the academic setting.
• Cost-Effective Tools: Used free frameworks (TensorFlow, OpenCV, Python, XAMPP).	• Short-Term Evaluation: No long-term or diverse environment testing was conducted.

Valid and Justified Recommendations for Improving the System

The following recommendations will be helpful to make the project better and more useful:

- Enhance Emotion Models: ResNet or EfficientNet models with transfer learning are more powerful and should be used. It can assist the system in capturing more emotions that are more precise.
- Fix IoT Hardware Problems: Replace jumper wire pins with more stable components such as GPIO shields or even wireless ones. This will ensure that the device connections are made reliable.
- Test More People: In the current state, only a few people were tested. It will be more reliable and fairer to increase it to 200-500 people of various backgrounds.
- Improve Response Authentication: Before alerts are delivered the user should be asked to confirm that the emotion persists over 2-3 seconds. This will eliminate false triggers.
- Enhance the Website: The Web site could be supplemented with new functionalities such as remote control, data storing in cloud, and presenting trends of emotions over time. This renders it more interactive to users.
- Engage Community and Industry: Share the system to the IoT and AI communities, and consider collaborating with entertainment or health industries. This will enhance the effects of the project and create a gateway to further development.

LO4 Reflect on the application of research methodologies and concepts.

P6. Discuss the effectiveness of research methods applied for the meeting objectives of the computing research project.

Reflective Writing

Reflective writing is a personal and analytic writing where the writer takes a critical look and analysis of their experiences, thoughts, or learning so, as to have a deeper insight and self-awareness. It is subjective in nature, because it does not merely characterize events, but goes further to analyze their meaning, examine feelings as well as relating them to theories, knowledge or future activities. Reflective writing is meant to foster growth through enabling someone to become aware of the strengths and weaknesses, make significant inferences and enhance their practice, decision-making, or thinking. Essentially, it is not only a journey of self-exploration but also a means of lifelong learning and growth, which is regarded as a combination of description, analysis, and evaluation into a reflective narrative (Moon, 2006).

Models of Reflective Writing

Reflective Theories present systematic frameworks that enable people to go beyond the act of remembering events to critically interpret and come to learn. The models facilitate the reflective process in various manners, some of which are cyclical and others question-based, yet all tend to tie together the experience with further understanding and effectiveness. With the help of these frameworks, learners and professionals will be able to analyze their actions, emotions, and results systematically, which will render the process of reflection more intentional and efficient.

- **Kolb's Experiential Learning Cycle:** This is a four-stage model where concrete experience, reflective observation, abstract conceptualization, and active experimentation are all part of the learning cycle and continuous learning is emphasized (Kolb, 1984)..
- **Gibbs' Reflective Cycle:** A six-step model (description, feelings, evaluation, analysis, conclusion, and action plan) that offers simple steps towards a structured reflection, particularly when one is starting out (Gibbs, 1988).

- **Johns' Model of Reflection:** This is a facilitated process that involves questioning experiences in depth in relation to self, other people, and fundamental context, which is frequently utilized in practice such as nursing (Johns, 1995).
- **Schön's Reflection-in-Action and Reflection-on-Action:** Reflection-in-Action is about reflecting in the present (to make appropriate responses in that situation) and after the present (to inform future behaviour) (Schön, 1983).
- **Atkins and Murphy's Model:** The focus on identifying disturbing experiences, critical reflection, and creating new viewpoints on learning as a continuing process (Atkins & Murphy, 1993).

Kolb's Experiential Learning Cycle

To reflect on my project, I decided to apply the Experiential Learning Cycle proposed by Kolb. Models of reflection are numerous but that of Kolb is very simple and clear. It analyzes four phases namely what happened, what I observed, what I learned and what I will do next. This is convenient to my project, which consists of the creation of an AI triggered Intelligent Emotion Recognition and Adaptive Response Recommendation System.

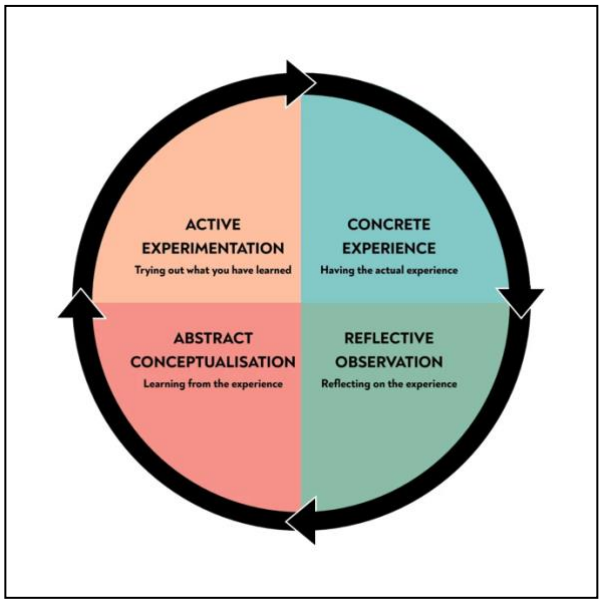


Figure 4.1 Kolb's Experiential Learning Cycle

Concrete Experience

In my project, I came up with an Intelligent Emotion Recognition and Adaptive Response Recommendation System that is AI-Powered. It was an individual project in which I did all of the phases independently like researching the background theories, gathering survey data, architecting, coding the prototype, testing and lastly, preparing the report and presentation. The project provided me with first-hand exposure of handling every part of a research and development project.

Reflective Observation

Looking back, I have realized that certain sections of the project were quite difficult. The coding of the IoT to match the system output and emotion detection outcome was one of the most challenging jobs. Numerous experiments were made to ensure that the output was functioning as desired with the emotions that were identified. The other challenge was that the model was sometimes not able to accurately detect face emotions, which was then determined to be a good result. Real-time detection was also a problem, as the system was required to reply fast and it happened that there was a delay in certain instances. Although these sections were challenging, they made me feel more confident about tackling more complicated technical issues on my own, as well as made me realize what areas my system required changes.

Abstract Conceptualization

This experience allowed me to know that completing a complete project independently needs high discipline, self-motivation, and time management. I also understood that research and development is not all about writing code, but it is also about getting deep into the problem, proving the ideas with facts and correcting the solution. I also learned that the issues like poor accuracy or low data are not failures but can be viewed as a learning experience that influences better results. Another lesson learned during this project was the need to document work in the best way possible so that my process and outcomes are clear.

Active Experimentation

To develop better in the future, I will gather bigger and more varied datasets to train the model, which should increase accuracy. I will also investigate more complex algorithms and methods to improve real-time detection. The other lesson that I will utilize is to begin testing earlier so I can identify the problems earlier and have an

opportunity to refine. In general, this reflection has demonstrated that I am able to self-manage complicated tasks, and I will take these competencies into my future academic and professional projects.

P7. Discuss the alternative research methodologies and lessons learnt in a view of the outcomes.

Research Approach

Without applying the deductive approach, there would be no organized method of testing the available theories like reliability of ultrasonic sensors. This would be dangerous to come up with a system that does not have a strong foundation of an established knowledge. Conversely, when the inductive element was not considered, valuable new information provided by the users would not have been enjoyed, rendering the system less responsive to real-life requirements. One cannot operate without the other since it may be either too theoretical or the system will be too blind to the expectation of the user.

Research Strategy

Without the experiments, the project would not be able to give tangible evidence of technical accuracy, speed, and reliability and the claims would not be verified. In the same way, without surveys, the user experience and confidence in the system would not be quantified, leading to a solution that can be technically successful but that is not adopted. A failure to employ the two strategies simultaneously would make the effectiveness incomplete.

Research Choice

Without mixed methods, when only quantitative system outcomes (accuracy, detection speed) are gathered, the project would lack the in-depth insight into user experiences. Conversely, when qualitative opinions are obtained exclusively, the technical reliability of the AI model would not be checked. The project would not offer a balanced assessment of the performance and user acceptance without the combination of both.

Time Horizon

In case the cross-sectional design was not adopted, the project could have tried to do a long-term study that cannot be completed within the academic time frame. Data collection would be random in system testing and surveys without an established time assigned to it, and incomplete results would be provided. The performance and acceptance of the system could not be measured with certainty.

Data analysis and data collection.

Without the quantitative data collection, the detection accuracy of the system, processing time, and recommendation success could not be validated, and the project might have seemed incomplete. Without the collection of qualitative data, user experiences regarding trust, satisfaction, and improvements would be overlooked, and system usability would be limited. Without one of them, the analysis would not reflect the complete efficiency of the AI-based IoT emotion recognition system.

M4. Analyze the results in the recommended actions for improvements and future research considerations.

Overview of Results Analysis

The Emotion Detection Entertainment Bot project is an AI-powered project that fulfilled its primary objective of integrating facial emotion recognition and interactive IoT entertainment. It was created in six months based on Deep Learning (CNN models), TensorFlow, and OpenCV and facial emotion recognition, as well as the IoT hardware (Arduino board with an OLED dashboard). A web-based interface was also developed, where a user was able to communicate with the bot, see the outcomes of emotion analysis, and also use customized playlists online. Back-end tasks (sending alert emails and storing preferences of the user) were done in PHP and MySQL.

The results of the survey from the primary research survey of 60 participants, results showed a strong interest in emotion-based technology, indicated the encouraging availability of interest in the technology. The number of participants who previously knew about facial emotion detection systems was only 32.3 percent, which indicates that the field is quite new, yet the rate of curiosity was quite high. Respondents also proposed that the system would be most handy in hospitals and mental hospitals, though a third also believed that schools, universities and home situations would also be fine. Regarding functionality, 48.4 percent of participants suggested that the system would play positive or uplifting music once the sadness is noticed, 43.5% wanted to be reminded of taking a break and 8.1% wanted to be informed of a contact or a friend.

Development challenges were related to the problem of stability of jumper pin connections in IoT hardware and the inability to record stable emotions detection in various lighting and face conditions. The advanced functionalities like multi-language voice Interaction and integration of smart home devices were out of scope because of time constraint but they can be added later. In general, the bot was successful in showing that it could recognize facial emotions in real-time and generate personalized entertainment experiences, which shows that the project was feasible.

Recommended Actions for Improvements

Some improvements can be suggested to make the system more effective. To start with, the system should be extended to voice-based interactions and multi-modal detection, which involves the facial expression in addition to voice tone and gesture

recognition. This would enhance the entertainment bot to be more natural and interactive. Also, the playlist functionality can be expanded with relaxation exercises, games, or guided exercises, which react to mood.

Second, there should be better accuracy and fairness of CNN model. The existing system is effective but limited by the low-scale size of the dataset. A bigger and more varied sample would minimize bias and enhance the recognition of all age groups, genders, and cultures. Accuracy could also be enhanced by transfer learning using models such as MobileNetV2 or ResNet50. False detections would be less and the system would be more reliable with addition of temporal validation (checking emotions during a few seconds and then confirming) to false detection.

Third, the website and IoT interface can be easier to use. OLED dashboard must be able to display simple emotion icons, besides text, so that they could be easily understood. The features that can be added to the site include user mood history, customizing playlists, and setting alerts. Multilingual support and development of the system to be compatible with assistive tools should be provided to increase the number of people, who are going to use the system with ease.

Lastly, the reliability of IoT hardware is to be enhanced. The problem of connections via the jumper pin may be addressed with either I2C modules or wireless connection (Wi-Fi/Bluetooth) to achieve stability. Notifications should be smarter and only sent when there are cases of prolonged negative emotional states, avoiding the unnecessary alert.

Recommended Actions for Improvements

Future research should tend to increase research base and system scalability. Probability sampling would be used to increase the sample size, to 500 or more, participants to get a more representative data so that there would be fairness among various groups of users.

To analyze data, more sophisticated software such as Python and R ought to be applied rather than Excel. This would enable the deeper patterns in user emotions and behaviors to be predicted and clustered and enhance the personalization of the system.

Lastly, practical testing at the real-life settings like hospitals, schools, and homes will be necessary. Such environment testing would be used to determine the

stability of the system, its effect on emotions, and its acceptance by the users in the long run. The cooperation with medical and educational workers might increase the number of aspects the bot might be used in a non-entertaining manner, serving as an important resource of psychological support, emotional awareness, and personal communication.

Justification of Recommendations

These suggestions are outlined in the findings and constraints that will be discovered in the course of the project. The sensitivity issues during testing are going to be directly dealt with by including more robust validation techniques, including multi-stage confirmation of emotions and fairness-conscious deep learning models. It will be facilitated with the use of more advanced frameworks like TensorFlow and Keras, as well as optimization strategies, in order to achieve higher accuracy and efficiency than the current CNN and OpenCV implementation.

The combination of cloud services and IoT middleware will resolve the problem of hardware constraints, including the unreliability of jumper pin connections when using the board, and the supply of seamless communication between the devices. To enhance the generalizability of the system, the testing should be extended beyond the classmates and supervisors and involve a more diverse group of users. Adaptive changes to the emotion detection AI and the personalized playlist recommendation engine will be supported by a longitudinal approach in which the system is tested over time. Lastly, the further interconnection of the IoT device and the site will enable users to use the system more naturally and provide usability, scalability, and sustainability.

D3. Demonstrate reflection and engagement in the resource process leading to recommended actions for future improvement.

Reflection and Engagement

The creation of the AI-Powered Emotion Recognition and Adaptive Response System was carried out in a systematic way in which various tools, techniques, and involved individuals were united to deliver the objectives of the project. This reflection offers an overview of the development steps, points at areas of involvement, challenges encountered, and lessons learned using the Kolb Reflective Cycle as a guide and proposes ways of improvement in future work. The most critical phases were primary and secondary research, system design and testing, and user engagement, which were implemented within the specified timeframe at a low cost using low-cost IoT and software technologies.

Title

Emotion Recognition and Adaptive Response System resource process was centered on low-cost equipment and effective ways of conducting research, development and testing. The resources were categorized in the following manner:

Primary Research Tools

Participants were surveyed to provide their views about the usefulness, trust and ethical issues of AI in emotion recognition. Questions were based on detection accuracy, usefulness of recommendations provided by the system, and the privacy concern of using cameras. The survey was administered via online platform through Google Forms and distributed via the use of messaging platforms (Discord, Telegram) which were free of charge and expandable to include a larger population.

Secondary Research Tools

The literature on the topics of AI emotion recognition, fairness algorithms, and adaptive response systems was reviewed in academic sources like Google Scholar and ResearchGate. Free online access and university library facilities helped in accessing the publications with little cost and paywall problems.

Development Tools

The development and testing of the system were performed with Python (with open-source machine learning libraries), Excel to analyze some basic data, and simulation environments to test adaptive responses. The total costs consist of Wi-Fi and connectivity, maintenance of personal devices and minor small costs. In general, the project was affordable because of using free community software and IoT-friendly tools.

Stakeholder Engagement

Guidance on the methodology, ethics, and system design was received through internal stakeholders (e.g., supervisors and peers). The external stakeholders (e.g., participants of the survey, possible users of the system, etc.) provided information of a great value in terms of feedback on accuracy, usability, and issues related to privacy and constant usage of the camera.

Reflective Observation: Evaluating Resource Effectiveness in the Emotion AI Project

When reviewing the resource process, some strengths and challenges were discovered:

Strengths

- Cost-efficiency: The project was made with the minimum cost depending on personal devices, open-source software (Python libraries, Excel), and free online tools. This enabled useful results and at a low budget.
- Accessibility: Online questionnaires were convenient to spread and a sufficient number of respondents was achieved in a limited time. Data collection was fast and cheap using Google Forms and social platforms.
- Ethical adherence: The privacy of the participants was observed. The surveys were anonymous and data was saved in password-protected devices, and ethics were upheld during the project.

Challenges

- Limited sample size: The survey contained a small number of participants whose sample size was comprised of the same age groups. This decreased diversity and brought up concerns about the external validity of the findings.

- Analysis tools limitations: The analysis with the help of Excel was helpful but not effective enough to test the pattern of emotion recognition in a more precise manner. More sophisticated programs like Python or R would have given more in-depth information.
- Availability of more recent literature: Part of the latest research on emotion AI and fairness algorithms was in the form of abstracts or preprints only, which did not allow conducting a more comprehensive review.
- Time factors: The time-based limitation of the six-month project did not allow including additional features, including real-time multi-modal emotion recognition based on facial or voice data.

Generally, the resource process was successful to develop the first prototype and to prove the idea. Nevertheless, it was also found to have drawbacks in scalability and depth of analysis as a result of cost, time, and technical limitations.

Key Insights from Resource Engagement in the Emotion AI Project

A number of lessons were learned as a result of the resource process that will be applied in future development. Sometimes free tools like Google Forms and Excel proved to be handy in small-scale data collection and testing, but turned out to be ineffective when working with large datasets, or more complicated tasks, proving superior to more powerful tools such as Python or R.

Non-probability sampling allowed an easy and cheap way of gathering data; however, it was more biased towards younger and technological-savvy groups, which lowered the diversity; probability-based sampling would raise representativeness, but it would also demand more time and resources. The stakeholder participation was useful, supervisors and peers provided guidance and encouragement, and survey respondents assisted in validating the requirements of the systems, pointing out the significance of wider involvement in subsequent practice. Privacy, anonymity, and informed consent were handled ethically to earn the user trust, but should be handled with care to prevent the possibility of abuse or mistrust particularly since the system has the capability of being used on webcams.

Lastly, six months was the right amount of time to do a cross-sectional study, yet it was not sufficient to get long-term emotional trend patterns, with longer-term studies being required in order to get more in-depth information. A combination of

these lessons demonstrates that careful planning and strong techniques are essential to use limited resources and build a reliable system that will be user-friendly.

Recommended Actions for Future Improvement

According to the reflection, the following recommendations are intended to address the resource constraints and will help in the development of a better version of the Emotion AI project in the future:

Adopt Advanced Analytical Tools

Changing the data analysis to Python or R will enable predictive modeling and clustering of emotional states, which the Excel lacks. This will make the insights more accurate and deeper. It is possible to keep costs down through open-source libraries such as Pandas, NumPy, and Scikit-learn in addition to enhancing technical expertise.

Expand Sample Size and Sampling Method

The next round of research should focus on 500 or more participants with different backgrounds and a probability-based sampling approach. This will decrease the bias of the existing small, largely youthful sample group and make the system more generalizable across various demographics, cultures, and emotional manifestations. Cost management could be achieved through partnerships with industry or academic institutions.

Incorporate Advanced Features

Support multimodal emotion recognition, e.g. real-time facial expression and speech tone recognition with CNNs, Transformers, etc. Such characteristics will make the system more precise and flexible, and costs of computer computations can be controlled with free frameworks such as TensorFlow and PyTorch.

Extend Time Horizon to Longitudinal Design

Perform a 6 to12 months longitudinal research to observe the dynamics of feelings and adaptive responses with time. This will overcome the constraints of the cross-sectional design and capture the seasonal or situational emotional changes, providing the AI with an opportunity to change as additional data is introduced.

Summary

Emotion AI project resource cycle was successfully implemented to create a working prototype within six months with the help of low-cost methods (Google Forms, Excel, Python libraries), stakeholder feedback, and AI methods. The practice demonstrated that effective findings can be achieved with low-cost strategies in case they are directed by ethical behavior and critical learning.

Nevertheless, the project was limited by the size of the sample, level of analysis and system characteristics. The improvements suggested, such as using more advanced tools, increased sampling, multimodal analysis, longer research periods, increased stakeholder engagement, and an improved ethics program will guarantee that the future iterations will be more precise, more all-encompassing, and more scalable without neglecting the resource limitations.

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Appendix

Logbook (1)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 11.4.2025
Update on weekly research/tasks achieved **Points to consider:** • The initial task that was given to us was to select the ultimate title of our project. • After brainstorming a number of ideas, I decided on a creative and innovative title of my project on human interaction and AI. • Once I had finalized the title, I began doing some background reading on comparable projects in facial recognition, gesture control, and intelligent entertainment robots. • I managed to collect some related resources and articles over the course of this week and went through the basic concepts behind my project.
Any risks and/or issues identified? **Points to consider:** • My project involves computer vision, gesture detection, and music integration — something that I have not tried out in its entirety before. • I am also concerned about whether the system will respond in the correct way to facial emotion and how to correlate those emotions into the correct responses. • The availability of the right sensors, e.g., a good webcam or gesture module, may also be difficult to implement.

Problems encountered

Points to consider:

- Challenge I encountered during my research is the difficulty of correlating real-time face recognition with gesture and sound-based feedback.
- I am less comfortable with machine learning libraries or frameworks like OpenCV and Media-Pipe, which I discovered are needed for this project.
- The tutorials I can discover are usually on facial recognition or hand gesture control separately, but not both, so I will have to piece together a few resources myself.

New ideas and change of project direction

- None

What have I learnt about myself this week?

Points to consider:

- I've reached the conclusion that even though the project scares me, I'm actually excited to work on it and challenge myself to learn new technologies.
- I was more fascinated by learning about AI advancements and smart systems than I expected.
- I'm a little bogged down by the sheer number of new ideas, but I'm assured to break it down step by step.
- I realize I need to better plan out my time and break down enormous issues into small achievable steps in order not to be stressed.

Tasks planned for next week

Points to consider:

- I will begin conducting a literature review of a minimum of three research articles on facial recognition, gesture-based systems, and AI-based music response systems.

- I will also list out the elements (hardware and software) which will be needed for implementation.

Have you set aside sufficient time for completion?

- None

Supervisor comments to address

Logbook (2)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 2.5.2025
Update on weekly research/tasks achieved **Points to consider:** • To carry out the literature review, I started searching for articles on gesture-based control systems, facial expression recognition, and AI entertainment bots. • Five literature reviews are required, and thus, I selected five relevant articles to review and analyze thoroughly.
Any risks and/or issues identified? **Points to consider:** • When searching for articles that directly incorporate my project idea, it was difficult to find sources that combine all three components (face reading, gestures, and entertainment responses) into one system. • Most articles address only one component like facial expression recognition or gesture control, so I had to search for various sources to match each component of the project.

Problems encountered

Points to consider:

- Although I was not able to find one article that exactly matched my whole project title, I was able to obtain individual articles from my instructors.
- They gave me useful websites like IEEE Xplore and Google Scholar, which helped me find good sources for each subtopic of the project.

New ideas and change of project direction

- None

What have I learnt about myself this week?

Points to consider:

- I was exposed to new AI technologies being created in real-time emotion detection and interactive robotics while reading through a lot of articles.
- I was not aware of most of the terms and even algorithms I came across, such as CNN-based emotion classification and pose estimation algorithms.
- I also familiar with new academic sites upon which I can read useful journals that are otherwise locked.
- I am now more at ease searching for academic content and know where to look in the future.

Tasks planned for next week **Points to consider:** • Since I have selected the required articles, I will be composing the first literature review next week. • I hope to summarize and criticize one of the three selected articles by the end of the week.
Have you set aside sufficient time for completion? • None
Supervisor comments to address

Logbook (3)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 16.5.2025
Update on weekly research/tasks achieved **Points to consider:** • I devoted this week to reading one of the three selected articles on the topic of my project. • The article was about the implementation of facial emotion recognition using AI models, particularly convolutional neural networks (CNN), and the correlation of emotion with automatic response in entertainment systems. • I conducted a detailed literature review of this article, noting the methodology, tools, and system architecture.
Any risks and/or issues identified? **Points to consider:** • While the article itself was very informative, it was filled with high-level technical jargon and in-depth system designs that were hard to understand at first. • I struggled to follow some parts which discussed real-time emotion sensing and sensor fusion with gesture response systems. • Since I have not worked with some of these models and frameworks before, I had to do additional background reading just to keep up with the overall flow of the paper.

Problems encountered

Points to consider:

- First, I found the article too technical, and I was not able to discern how the different AI components were being integrated.
- However, after reading it slowly and looking up unfamiliar terms and systems (facial landmarks mapping and OpenCV integrations, for example), I was able to piece the concepts together.
- In the end, I was finally able to complete the literature review with a much clearer idea of the underlying technologies involved.

New ideas and change of project direction

- None at the moment, but the article actually gave me an idea of adding more features like emotion-based sound recommendations, which I can explore.

What have I learnt about myself this week?

Points to consider:

- I learned that I can learn new things quicker than I ever imagined, especially when I focus and take the effort to study additional material.
- This article pushed me to become more self-sufficient in technical reading and developed my ability to pull out relevant information from academic texts.
- I also learned that constant effort, even when I do not understand at first, eventually leads to good progress.

Tasks planned for next week

Points to consider:

- I will start the literature review of the second article, which involves more gesture recognition and hardware integration.
- I also plan to sketch an initial system design showing how facial detection, gesture modules, and sound output will come together in my project.

Have you set aside sufficient time for completion?

- None

Supervisor comments to address

Logbook (4)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 30.5.2025
Update on weekly research/tasks achieved **Points to consider:** • Passed the final two literature reviews, paying attention to the most recent advances in object detection systems and collision avoidance systems. • Came up with an elaborate Work Breakdown Structure (WBS) to plan and structure the project stages better. • Further deepening my knowledge about the main technologies connected with the project, especially regarding the sphere of IoT and sensor-based systems.
Any risks and/or issues identified? **Points to consider:** • There were no significant technical problems which were faced this week. The increasing knowledge of the topic matter contributed to minimizing confusion and enhancing the effectiveness of the research. • Nonetheless, I also had a tangible drop in my motivation, which contributed to the procrastination of the literature reviews. This did not have much influence on time management and I was able to reach the targeted deadlines.

Problems encountered

Points to consider:

- The primary problem of this week was the ability to be motivated constantly. Consequently, the literature reviews were not developed as fast as expected.
- Luckily, I could recover my concentration and do the required work after having had some rest and a bit of light entertainment. This was a reminder of the need to have a good work life balance when working on intensive projects.

New ideas and change of project direction

- No new ideas or changes to the project direction were introduced this week. The current plan and goals remain on track.

What have I learnt about myself this week?

Points to consider:

- I found out that regular rest and self-care are important in keeping motivation and productivity.
- I was also able to see a wider perspective of the applicability of IoT in other fields, including health care, education and industrial systems, and this has broadened my understanding of its potential beyond just automotive uses.

Tasks planned for next week

Points to consider:

- Prepare a final literature review which summarizes and compares the results of the three literature reviews done up to date.
- Prepare a time estimation table in order to plan future milestones.
- Start writing the project proposal document in detail, and incorporate the research and planning that has been undertaken till now.

Have you set aside sufficient time for completion?

- Although this week had to take time in accomplishing the tasks, as I had some motivational setbacks, I was able to meet the deadlines. To be more focused and productive in the future, I will dedicate additional time in case of unforeseen delays and be more balanced in my schedule.

Supervisor comments to address

Logbook (5)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 11.7.2025
Update on weekly research/tasks achieved **Points to consider:** • Developed a time estimation table of the whole time of the project using the class timetable but excluding the assignment days and holidays. • Drafted the original project proposal document that specified goals, requirements and planned milestones. • Determined the principal electronic components and hardware required in the gesture-response element, and began searching appropriate locations to buy them.
Any risks and/or issues identified? **Points to consider:** • Time estimation table had a small problem and faced a slight mistake in dates and timings that had to be fixed. • Locating and purchasing the proper parts was an extended process as well since it was slightly difficult to find trustworthy stores and physically commute to them.
Problems encountered **Points to consider:**

- This week I faced certain time management issues because of balancing project work with my other academics.

New ideas and change of project direction

- No new ideas or changes to the project direction were introduced this week. The current plan and goals remain on track.

What have I learnt about myself this week?

Points to consider:

- During the time that I was trying to find the required parts of the hardware, I had to get to know more about various types and specifications of electronic components that I did not know before.
- I learned that I needed to verify my time schedules twice and that there would be plenty of other surprises such as finding hardware.

Tasks planned for next week

Points to consider:

- Complete the proposal on the project.
- Get and buy any components left, and begin to assemble the primary hardware set-up.

• Initiate some basic testing to ensure the hardware reacts appropriately to basic command.
Have you set aside sufficient time for completion? • Nevertheless, even though these setbacks are quite minor, I think that the time allocated is still sufficient to accomplish the tasks going by the given time, provided that I stay focused to work.
Supervisor comments to address

Logbook (6)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 25.7.2025
Update on weekly research/tasks achieved **Points to consider:** • Connected the ESP32 development board to an OLED display that will give an end result message and status. • Tested and wired a system of a servo motor with the ESP32. • The sensor information and the servo motor angle were programmed through the I2C onto an OLED screen. • With the assistance of my supervisor, I also learned how to layout jumper wires, power the parts safely and write simple Arduino codes to carry out control logic.
Any risks and/or issues identified? **Points to consider:** • The OLED display would not read at first, due to the incorrect I2C address; this was resolved by reading the information and with the help of my supervisor. • Conflicts occurred during early attempts to work with ESP32 libraries using OLED and servo; it was required to obtain the use of the appropriate library versions and pin configuration.

Problems encountered

Points to consider:

- This week I faced certain time management issues because of balancing project work with my other academics.

New ideas and change of project direction

- None

What have I learnt about myself this week?

Points to consider:

- I have become better at debugging wiring of circuits and tracing them in real-time using serial monitor.
- I find it easier to write code now to support multiple devices operating at the same time on a microcontroller.
- I feel like this week made me understand that I like working with interactive objects and embedded systems a lot more than I did before.

Tasks planned for next week

Points to consider:

- Train more data in the facial sample so as to enhance the performance of accuracy and reliability of the facial recognition across changing angles and illuminating conditions.
- Start the process of configuring all components of IoT, so that they work in sync with each other, such as face recognition which activates movement of

servos, and the image of the element of feedback displaying on the OLED screen.
Have you set aside sufficient time for completion? •
Supervisor comments to address

Logbook (7)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 8.8.2025
Update on weekly research/tasks achieved **Points to consider:** • The code was tested and revised further to enhance the ability of the ESP32 development board to communicate with the other connected IoT devices including the OLED screen and the servo motor. • Successfully trained more facial data samples using the camera module to get better detection accuracy with varied lighting conditions and orientation of the face. • Initiated the set up to package all IoT components to work in synchronization. Particularly, face recognition was to carry the task of comprehensive triggering the servo motor and updating the OLED display respectively.
Any risks and/or issues identified? **Points to consider:** • The face recognition training process is more time consuming than it should be because of the variability of lighting and inconsistent image capture. • There were several delays in setting up the behavior of the servo motor with relation to the activation of the sensors. • Managing that time is still a stress as testing, training, and documentation are all going on.

Problems encountered

Points to consider:

- This week I faced certain time management issues because of balancing project work with my other academics.

New ideas and change of project direction

- None

What have I learnt about myself this week?

Points to consider:

- Learning real-time facial recognition and device control actually made me more interested in embedded systems and AI integration.
- I have learned that proper documentations of wiring and codes considerably ease the troubleshooting process and saves the usage of time in the further steps.
- There are some difficulties, but on the other hand, I am getting more patient and more capable of solving problems, as I face component breakdowns and debugging.

Tasks planned for next week

Points to consider:

- Develop a website with a database store user and song data for recommendation process using user emotions.
- Reporting and presenting the obtained results.

Have you set aside sufficient time for completion? • All the tasks were completed on right time.
Supervisor comments to address

Logbook (8)

Name: Htet Zaw Paing
Project Title: AI Real-Time Facial Emotion Recognition and Response System
Date: 22.8.2025
Update on weekly research/tasks achieved **Points to consider:** • Focused on setting up the IoT system. • Developed the website to display and manage IoT results. • Worked on reflective writing related to the project. • Completed all planned tasks for the week. • Stayed aligned with project objectives and deadlines.
Any risks and/or issues identified? **Points to consider:** • The face recognition training process is more time consuming than it should be because of the variability of lighting and inconsistent image capture. • There were several delays in setting up the behavior of the servo motor with relation to the activation of the sensors. • Managing that time is still a stress as testing, training, and documentation are all going on.
Problems encountered **Points to consider:** • Inability to show the results correctly, according to emotion recognition. • There was a scarcity of time leading to the pressure on accomplishing tasks.

- Require sophisticated algorithms and modification to enhance accuracy.
- Delay risk in case time management is not actively maintained.

New ideas and change of project direction

- None

What have I learnt about myself this week?

Points to consider:

- Trained to be flexible and resolve issues when having technical difficulties.
- Better time management capability during stress.
- Discovered things that were helpful in both career and personal development.
- Learned the value of hard work and discipline.
- Acquired confidence in the ability to balance across various project demands.

Tasks planned for next week

Points to consider:

- None

Have you set aside sufficient time for completion?

- All the tasks were completed on right time.

Supervisor comments to address

Literature Review

Abstract

In the present review, the recent studies of facial emotion recognition (FER) and its application in interactive entertainment are examined. The most common way to classify human facial expressions using deep learning, especially convolutional neural networks (CNNs), is through transfer learning, better loss functions, and data augmentation, which are methods performed by many researchers. As an example, Zhai et al. (2017) achieved an accuracy of high levels on popular FER datasets with the help of CNN-based model with modification of softmax-MSE loss and two-activation layers. In other research papers, there is the unraveling of how the identified emotions can result in various responses of the systems. Taking an example, Pedapaga et al. (2022) outline a Python and OpenCV pipeline that takes pictures with a webcam, gets an emotion through Keras CNN, and then recommends playlists with music to correspond to the mood. The moderately accurate range of such systems is typically between 50-70% and they are typically characterized by constraints in emotion labels and overfitting. In general, this piece of work provides us with a foundation of building our smart bot. It demonstrates that CNNs (with TensorFlow or PyTorch) can be already applied to real-time FER, however it notes that real-time processing needs to be more reliable and the output more descriptive, which has not yet been fully implemented (gestures, alerts etc).

Introduction

Facial Emotion Recognition (FER) is significant in the human computer interaction, and it is applicable in other domains such as robotics, gaming, and smart devices. Single computer architectures Deep convolutional neural networks (DCNNs) have evolved to be the primary technology of FER systems. As an example, the study by Zhai et al. states how DCNNs

that have been trained on larger face-recognition dataset can be calibrated to detect emotions, removing the issue of limited FER-specific data. Such models must categorize various emotions e.g. happiness, sadness or anger but small amounts of data might give way to overfitting. The other problem is the application of the identified emotions in entertainment. Music recommendation is a good example. Music has a great impact on mood and everyday life, and hence a system may produce playlists and play songs, which is keen on the mood of a user based on their faces. This review examines the manner in which recent researches address these challenges. It is concerned with (1) CNN-based FER methods, and (2) complete systems tying emotion detection to actions such as gestures or music. The point is to search the methods how to integrate these concepts into a smart bot that would utilize with emotions and reply to them by playing music, making gestures, or sending alerts.

Main Body

CNN-Based Facial Emotion Recognition

Zhai et al. (2017) showed deep CNN based facial emotion recognition (FER) approach which addresses overfitting via transfer learning and architecture-specific network designs. They used a network pre-trained on face recognition task and went further to fine-tune it on emotion datasets (FER2013 and SFEW.2) using powerful data augmentation methods. They have increased performance by complicating performance with a double activation layer (ReLU and maxout combination) and a special loss function Softmax -Mean Squared Error. Out of their experiments, the model was achieving around 48.5 and 59.1 percent accuracies on SFEW2.0 and FER2013 respectively, which was sated-of-art at the time. The authors mention that some emotions such as neutral and disgust are hard to distinguish and thus this reduced the total accuracy. This paper demonstrates that deep learning is effective when learning facial expression but also points to the fact that the accuracy remains low particularly on real-world images. It is proved that data

augmentation (cropping and flipping, in particular) assists in the prevention of overfitting. In general, the study by Zhai et al. forms a solid foundation of FER research by demonstrating the conversion of the technique of DCNNs (created with the use of such application as TensorFlow or Keras) into one by using transfer learning and adding new layers. Nevertheless, this approach addresses emotion detection and does not elaborate on what to do with these detected emotions thereafter.

Emotion-Driven Music Recommendation System

Extending FER (CNN-based), Pedapaga et al. (2022) talk about a full solution to select music with the help of facial emotion recognition. Their installation uses a webcam to stream the face of the user on the OpenCV library of cv2. The user emotion is predicted by a pre-trained Keras CNN (with 48x48 grayscale images) because the model outputs probabilities on the last layer, which is a Softmax layer. The probability of an emotion with the lowest probability is chosen. The five target moods were used (Angry, Happy, Sad, Fear, Neutral). To give an example, when the system finds the word “Happy” it opens a list of joyful songs. They created a user-friendly interface in Python (consisting of Tkinter), applied the pygame module to play music and display the names of songs. To avoid overfitting they used data augmentation in training and even tested the system using some run examples. Their paper demonstrates face capture screenshots and user interface running screenshots. The most significant input is the demonstration of the fact that FER can be directly associated with a music player. Nevertheless, the study has limitations: they did not provide actual results of accuracy, and did not design user studies. They also did not manage to touch on all of the basic seven emotions and prefer to do so in the future. The used tools are not exotic: Python, OpenCV, Keras, and Tkinter. This is compatible with the technology stack we are adopting in our own project as well since we are also adopting Python and using live video to detect emotions. In general, the creation is a decent reference to associating FER with the results of music but it lacks other

feedback behaviors such as motion and prompts, as well as a more detailed testing would be beneficial.

Real-Time and Robotic Extensions (Recent Advances)

Most recent studies have been made on real-time and fully integrated systems. As an example, Bhagat et al. (2024) present the description of a FER system based on CNN that uses live video streams. Their abstract describes that they employ up-to-date models of CNN along with a video stream input, which, quite likely, is an MTCNN face detector with a CNN applied to emotion recognition. Real-time pipelines include those that do the work on each frame of the video as it is received and thus are relevant in an interactive bot. Bhagat et al. point out the described pipelines as fast face detection (via the MTCNN method by Zhang et al.) to detect faces in unconstrained live video and then classify the detected expression immediately. This solution suits our strategy: we also capture webcam frames continuously and apply trained CNN to every frame. Similar to the one in IRJMETS, the described live approaches exploit Python and OpenCV to obtain videos and deep learning methods to conduct predictions. It is characteristic of the industry: the shift of offline image recognition to an always-on video analysis allows a bot to respond immediately.

Conclusion

Based on reviewed articles, CNN-based facial emotion recognition (FER) has come out an established system that accurately extracts the basic human emotions out of the images or a video file. Transfer learning, special loss functions and data augmentation have enabled the models to achieve close to 50-70% accuracy on the generic data sets. These models may be applied to entertainment, e.g. to the knowledge of irritating mood of the user and playing the corresponding music. Nevertheless, there are still some difficulties. The accuracy on subtle or rare emotions (such as neutral or disgust) remains low, and the majority of the systems identify

a few emotions. Insufficiently, lots of studies pay attention to audio responses and exclude physical gestures or movements of robots.

Briefly, FER offers a solid foundation but at present, there are no fully integrated multi-output bots offered by existing systems. Future efforts ought to enhance precision (by use of larger databases and superior CNNs), recognize more emotion kind, as well as use more significant responses. As an example, it can be suggested to increase the number of covered emotions in the IRJMETS system (to seven), or introduce visual alerts that can transform a system into something more interesting and engaging.

Some of these gaps are addressed in our project. The OpenCV real-time video is processed via a CNN FER model in Python (using TensorFlow/Keras). Our selected servo with an ESP32 can be connected as well to provide easy robotic motions and an audio output to play music. This demonstrates that an IoT-software bot can be used to recognize the emotion of the user and react to it with music and nice gestures.

In conclusion, the present researches provide some good tools and initial examples, and more research is required to create full-fledged, human-like emotion-aware systems. The fixation of future designs are to incorporate superior CNN models, more diverse information, and feature components that can actually assist people in day-to-day life.

References

Tarnowski, P., Majkowski, A., Kołodziej, M., & Rak, R. (2017). Deep Convolutional Neural Network for Facial Expression Recognition. SpringerLink [Online]. Available from:

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Access Date: 4.6.2025

Research Ethics Approval

Section One: Basic details

Project title: AI Real-Time Facial Emotion Recognition and Response System

Student name: Htet Zaw Paing

Student number: -

Programme: Higher National Diploma (HND)

School: Info Myanmar College

Intended research start date: 07.04.2025

Intended research end date: 27.08.2025

Section Two: Project summary

Please select all research methods that you plan to use as part of your project:

- Interviews ☐
- Questionnaires ☑
- Observations ☑
- Use of personal records ☑
- Data analysis ☑
- Action research ☐
- Focus groups ☑
- Other (please specify): …….

Section Three: Participants

Please answer the following questions, giving full details where necessary.

Will your research involve human participants?

- Yes, my research involves human participants.

Who are the participants? Tick all that apply:

Children aged 12–16: ☐ Young people aged 17–18: ☑ Adults: ☑

How will participants be recruited (identified and approached)?

- Include students and academic staff members, which work on or study IoT-related topics.
- Engage IT experts and people working in other fields to have an eye-opening opinion on how IoT works in reality.

Describe the processes you will use to inform participants about what you are doing:

1. **Information Sheet**
   A simple sheet will describe the objective of the project, and how the emotion or facial data will be utilized, and what is required of the participants.
2. **Verbal Explanation**
   I will simply describe the project, how emotion detection and music interaction works, and respond to questions.
3. **Right to Withdraw**
   The participants have free choice to abandon the project at any point without causing a reason.
4. **Data Privacy**
   All information will remain confidential, stored in a safe place and will not be utilized other than academic purposes.

How will you obtain consent from participants? Will this be written? How will it be made clear to participants that they may withdraw consent to participate at any time?

The participants will also be provided with a clear written consent form when they are being served with the survey form. This makes the process transparent, comprehensible, and legal. It will clearly indicate that it is optional and they can end it at any time without any reason. A verbal explanation will also be done before participation.

Studies involving questionnaires:

Will participants be given the option of omitting questions they do not wish to answer?

Yes: ☑ No: ☐

If 'No' please explain why below and ensure that you cover any ethical issues arising from this:

Studies involving observation:

Confirm whether participants will be asked for their informed consent to be observed.

Yes:☑ No: ☐

Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?

Yes: ☑ No: ☐

Will participants be given information about the findings of your study? (This could be a brief summary of your findings in general.)

Yes: ☑ No: ☐

Section Four: Data storage and security

Confirm that all personal data will be stored and processed in compliance with the Data Protection Act (1998):

Yes: ☑ No: ☐

Who will have access to the data and personal information?

The project researcher and the individual "Htet Zaw Paing" will be the only people that access the information and materials gathered along with personal details. Any information will be saved safely and applied only to academic purpose. Personal information will not be given or published.

During the research:

Where will the data be stored?

The data will also be stored in a password-enabled computer and kept also in an encrypted drive. "Htet Zaw Paing" will be the only person who has access to the data, and the information will only be utilized academically in this project.

Will mobile devices (such as USB storage and laptops) be used?

Yes: ☑ No: ☐

If yes, please provide further details:

Yes, USB storage and laptops will also be used both to create convenience and flexibility in data collection and analysis. With these devices, I can work in various places, and access files quickly as well as transfer data easily without compromising the data security measures (e.g., data password protection and encryption).

After the research:

Where will the data be stored?

The data will be safely stored on password-secured device after the project is complete. It can be used only academically. Within a couple of years after the project, the data will be deleted permanently to ensure privacy of participants.

How long will the data and records be kept for and in what format?

The information will be stored not later than 3 years when the project is over. This will be saved in digital (E.g. excel files, pictures, or videos) on an encrypted device. Soon after, every information shall be destroyed permanently to maintain privacy, and security.

Will data be kept for use by other researchers?

Yes: ☐ No: ☑

If yes, please provide further details:

Section Five: Ethical issues

Are there any particular features of your proposed work which may raise ethical concerns? If so, please outline how you will deal with these:

Informed consent

Survey respondents will clearly understand the objectives of the project, the type of information which will be gathered (survey response only) and how the data will be utilized prior to participating in the survey. The process of the participation is completely voluntary, and the respondents reserve the right to move out of the process at any moment with no explanation.

Potentially vulnerable participants

In case the survey involves those with special needs or disabilities, extra measures will be taken in order to provide access to those of them in order to realize full comprehension of the survey and consenting process. All the participants will not be threatened or subjected to pressure to participate.

Sensitive topics

Participants will be informed ahead of time since the survey will contain questions on emotional states or wellbeing. They will be handled with dignity and they are free to skip the question or even quit the survey whenever they consider it uncomfortable.

Risks to participants and/or researchers

The survey is self-reports only and no actual facial expression or measures of a biometric nature are being recorded or analysed. The physical and emotional harm is low and is controlled safely during the study.

Confidentiality/anonymity

Survey responses will not be kept or recorded together with personal identifiers. All data on each participant will be coded uniquely to anonymize it to protect the identity. The anonymized data will be inaccessible to anyone, except the researcher.

Disclosures/limits to confidentiality

It will be explained to the participants that data confidentiality will be well-guarded but a temporary access might be given to technical support people, but on a condition of strong confidentiality.

Data storage and security, both during and after the research (including transfer, sharing, encryption, protection)

The survey data will be kept under encryption on encrypt-able devices with the additional copy saved in the encryptions on cloud storage which will be secured by a password. They are not going to publicly publish or disclose any data except the research team.

Reporting

When reporting the results, the researchers will be honest, clear and will use overall statistics and summaries without including any personal or identifying details.

Dissemination and use of your findings

The results of the survey will only be utilized on academic grounds including research reports and university presentations. Data will not be subject to any commercial use or would be disclosed in a manner that violated the privacy of participants.

Section Six: Declaration

I have read, understood and will abide by ***[Info Myanmar College]*** Research Ethics Policy:

Yes: ☑ No: ☐

I have discussed the ethical issues relating to my research with my Unit Tutor:

Yes: ☑ No: ☐

I confirm that to the best of my knowledge:

The above information is correct and that this is a full description of the ethics issues that may arise in the course of my research.

Name: Htet Zaw Paing

Date: 20.7.2025

Please submit your completed form to: Dr. Moe Arkar Lwin, Daw Thae Nandar Aung

Communication Plan

A communication plan is a guide for how information about the project will be used to communicate effectively. It makes sure that updates, findings and technical details are clearly delivered to the right audience. In the Smart Entertainment Bot project, the stakeholders are directed in methodologies for written, oral and technical communication to ensure smooth progress and presentation of successful results.

<table>
<tr><td colspan="2">Communication Plan</td></tr>
<tr><td>Project Name: AI-Powered Intelligent Emotion Recognition and Adaptive Response Recommendation System</td><td>Beginning Date: 7.04.2025</td></tr>
<tr><td>Project Manager: Htet Zaw Paing</td><td>End Date: 27.08.2025</td></tr>
<tr><td colspan="2">Project Owner: Htet Zaw Paing</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Project Objective and key points (high level):

- Build the whole face detecting emotions software programmed by using computer vision technology and machine learning.
- Give the system that is precise, reliable, and stable in recognizing different human feelings.
- Increase the human computer interface to promote real time emotional reaction (e.g. music, expressions, speech).
- Make the user experience personal as the recognition of the owner’s face and prioritization is made.
- Promote emotional health, and entertainment with the help of a robotic device, on which people can interact.
- Undertake surveys and assessments to seek feedbacks about the users and prove the work of the system and its effectiveness.
- Use emotion-related data in an ethical way in order to advance the progress of affective computing in the future.</td></tr>
<tr><td colspan="2">Stakeholders – Target audience (list)

- Internal Supervisors</td></tr>
</table>

- External Supervisors
- Survey Participants
- Classmates
- IoT Supplier
- Parents
- Student Services Division

Timeline (Date)	Team Member (responsible for communication)	Target (audience)	Tool (medium for communication delivery)	Message Points
7.4.2025 to 27.8.2025	Htet Zaw Paing	Internal Supervisors	In-person meetings, Telegram, Discord	Project progress updates, discussion on technical challenges, milestone reviews
7.4.2025 to 27.8.2025	Htet Zaw Paing	External Supervisors	Telegram, Discord	External feedback on methodology, ethical review, and system performance
24.7.2025 to 1.7.2025	Htet Zaw Paing	Survey Participants	Google Forms, Discord, Telegram	Consent, purpose of the survey, data privacy, and brief system explanation
7.4.2025 to 27.8.2025	Htet Zaw Paing	Classmates	Group-chat (Telegram/Discord), Presentation	Sharing project ideas, gathering opinions, collecting peer feedback
15.7.2025	Htet Zaw Paing	IoT Supplier	Website, Phone, In-person	Ask about availability of needed components, item prices, delivery time, and shipping duration

7.4.2025 to 27.8.2025	Htet Zaw Paing	Parents	In-person, Phone call	Informing project workload, progress, and support needs

Performance Review

Performance Review

- What was the project supposed to accomplish?

  The direction of the project was to design and develop a smart entertainment bot based on AI that would be able to identify human emotions on their face in real time and react to it with a personalized playlist of music, expressive gestures, and notifications. The overall idea was to make entertainment more interactive and supportive as well as assist users in gaining greater awareness about their emotional state.

- Did the project succeed in its aims? How do you know? Specifically, outline any evaluation and assessment undertaken.

  Yes, the project met its key goals in the specified time. The Bot was able to recognize facial expressions with fair accuracy, create emotion-driven playlists and show responsive gestures using its hardware parts. My supervisor, me and my classmates conducted evaluation and testing. Their feedback proved that the system was operating as planned and that it achieved its main goals.

- What things do you think worked well and why? Evaluate all aspects of the project (e.g. initial inception, project activities and project outcomes) from a range of perspectives.

  In the project, most of the elements performed especially well:

  - Initial conception: Research onion approach offered a good guideline to how the research and development would be designed.

- Project activities: Surveys and literature reviews were used to make sure that the project was designed in accordance with user needs and aligned with the current AI developments.
- Project deliverables: The Bot was able to integrate AI emotion recognition and interactive capabilities, which were considered interesting and useful by users.

Such achievements can be greatly attributed to the fact that there was proper planning, good user input and the inclusion of primary and secondary research.

- What problems emerged during the project and how were they tackled? Was there timely identification of issues and resolution during the project process?
  - The issue with timeliness of survey responses was one of the problems that affected the analysis phase. This was overcome by reformatting the form and inviting more respondents to fill it in.
  - The other problem was the time constraint as more advanced functionalities such as multi-language voice response or smart home integration had to be pushed back. The project was instead centered on the basic functions of the project-emotion recognition, playlist generation, gesture response, and notification system- and the delivery of a working prototype within six months.
  - Also, when developing the IoT, the hardware connection problem was encountered in the form of jumper pins port misalignment and unstable wiring to the board that resulted in sensor and module connection errors. This was sorted by resettling the wiring plan, discuss with my supervisor, attaching the jumper pins firmly and verifying every connection in the modules one at a time to ensure the lack of loose contact.
- What did you learn from undertaking the project?

  The project made me understand that it is necessary to balance both the technical objectives and time limitations because not all features that was desired could be added at the initial version. I also got to know the importance of user feedback when creating usable AI systems since surveys and assessments influenced the design process. Moreover, I was able to gain practical knowledge in the area of integrating AI (deep learning in face recognition) with hardware reactions, which

empowered my skills in creating active, real-life systems, linking entertainment with emotional intelligence.

- How would you rate your performance as project manager?

Category	**Rating (1–5)**
Time Management	3.5
Self-Assessment	4
Personal Communication	4
Problem Solving	4.5
Technical Skills	4.5
Overall Rating	**4.3**

- What strengths and weaknesses of your performance did you identify?

Category	**Strengths**	**Weaknesses**
Time Management	Managed to complete core system within project deadline.	Sometimes delayed in testing phases, needed better scheduling.
Self-Assessment	Regularly reflected on progress and identified areas for improvement.	At times, self-criticism led to overthinking instead of quick adjustments.
Personal Communication	Clear updates with supervisor and effective discussion with classmates.	Could improve on documenting communication more formally.
Problem Solving	Strong in debugging software and fixing connection issues.	Hardware troubleshooting (e.g., jumper pin alignment) took longer than expected.

Technical Skills	Successfully integrated AI emotion detection and IoT functions.	Limited exposure to advanced hardware optimization due to time constraints.

- How will this inform and support your continuous professional development?

  The project has taught some wise lessons in my learning that would inform my lifelong learning. I enhanced my belief in using AI emotion detection alongside IoT applications; it is also necessary to note that there will be areas to improve, such as dealing with hardware-related problems, such as jumper pin connections, and manage time better when testing. The experience has shown that I need to develop my planning and scheduling plans, improve my practical IoT integration capabilities, and keep on developing expertise in the AI system design. Moreover, the process enhanced my workflow and reporting skills through documentation, which will enable a clearer workflow and reporting in future projects. Altogether, all these lessons will enable me to be more technically competent, efficient, and flexible in future projects.