SCHOOL OF COMPUTER SCIENCE ENGINEERING AND INFORMATION SYSTEMS

WINTER SEMESTER 2024-2025

PMCA504L – SOFTWARE ENGINEERING

DIGITAL ASSIGNMENT
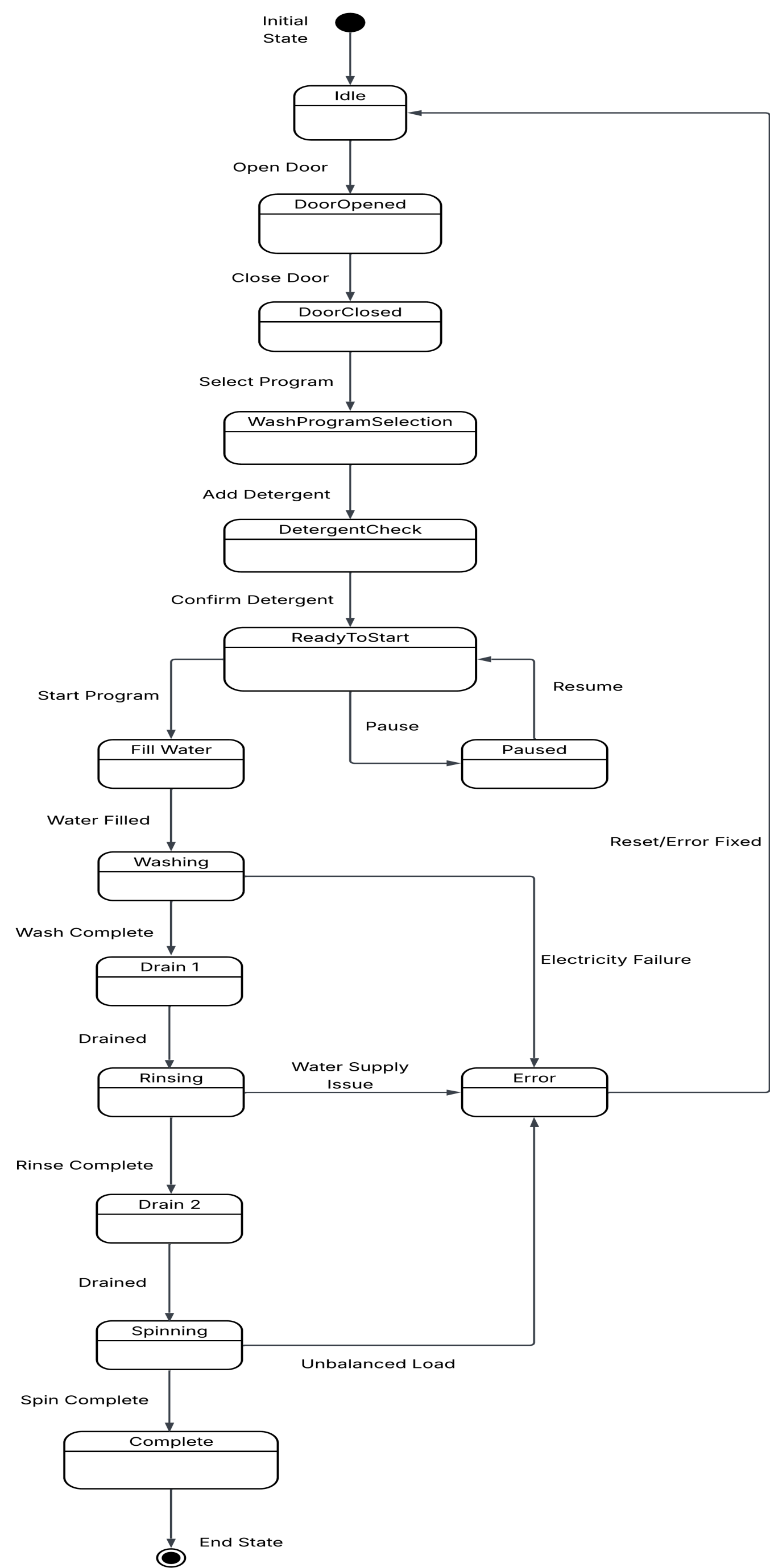
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Q1. Draw state machine models of the control software for: An automatic washing machine which has different programs for different types of clothes.

Explanation:

1. Initial State – Idle

- ➢ The washing machine begins in the **Idle** state, which represents the default condition when the machine is powered on or reset.

2. Door Handling

- ➢ From the **Idle** state, the user can open the machine door, transitioning the system to the **DoorOpen** state (where the user puts clothes in the machine).

- ➢ After the door is open, closing it moves the system to the **DoorClosed** state.

3. Wash Program Selection Phase

- ➢ Once the door is closed, the user may select a desired washing program (such as cotton, wool, or delicate).

- ➢ After selecting the program, the user is prompted to add detergent.

- ➢ When detergent has been added and confirmed, the system becomes ready to start the wash cycle.

4. Washing Cycle Execution

➤ The washing cycle begins when the user starts the program, transitioning to the **WaterFill** state.

➤ Once the water is filled, the system proceeds to **Washing** state.

➤ After the wash cycle completes, the water is drained (Drain-1), followed by a rinsing phase which transitions the machine to the **Rinsing** state.

➤ Once rinsing is complete, the water is again drained (Drain-2), after which the system transitions to the **Spinning** state.

➤ After spinning is complete, the machine moves to the **Complete** state which indicates that the washing process is complete.

➤ Finally, the machine proceeds to the **End** state.

5. Pause and Resume Functionality

➤ The user also has the option to pause the machine before or during the start of the program from **ReadyToStart** state.

➤ The process can be resumed from the paused state, offering flexibility and control.

6. Error Handling

➤ The system includes comprehensive error detection at key stages, ensuring robust operation. Specific failure points and their transitions to the Error state are as follows:

Component	Error Transition
Washing	Washing → Error: Electricity Failure
Rinsing	Rinsing → Error: Water Supply Issue
Spinning	Spinning → Error: Unbalanced Load

➤ Once the issue is resolved or reset by the user, the system returns to the **Idle** state.

Q2. Draw state machine models of the control software for: The software for a compact disc player.
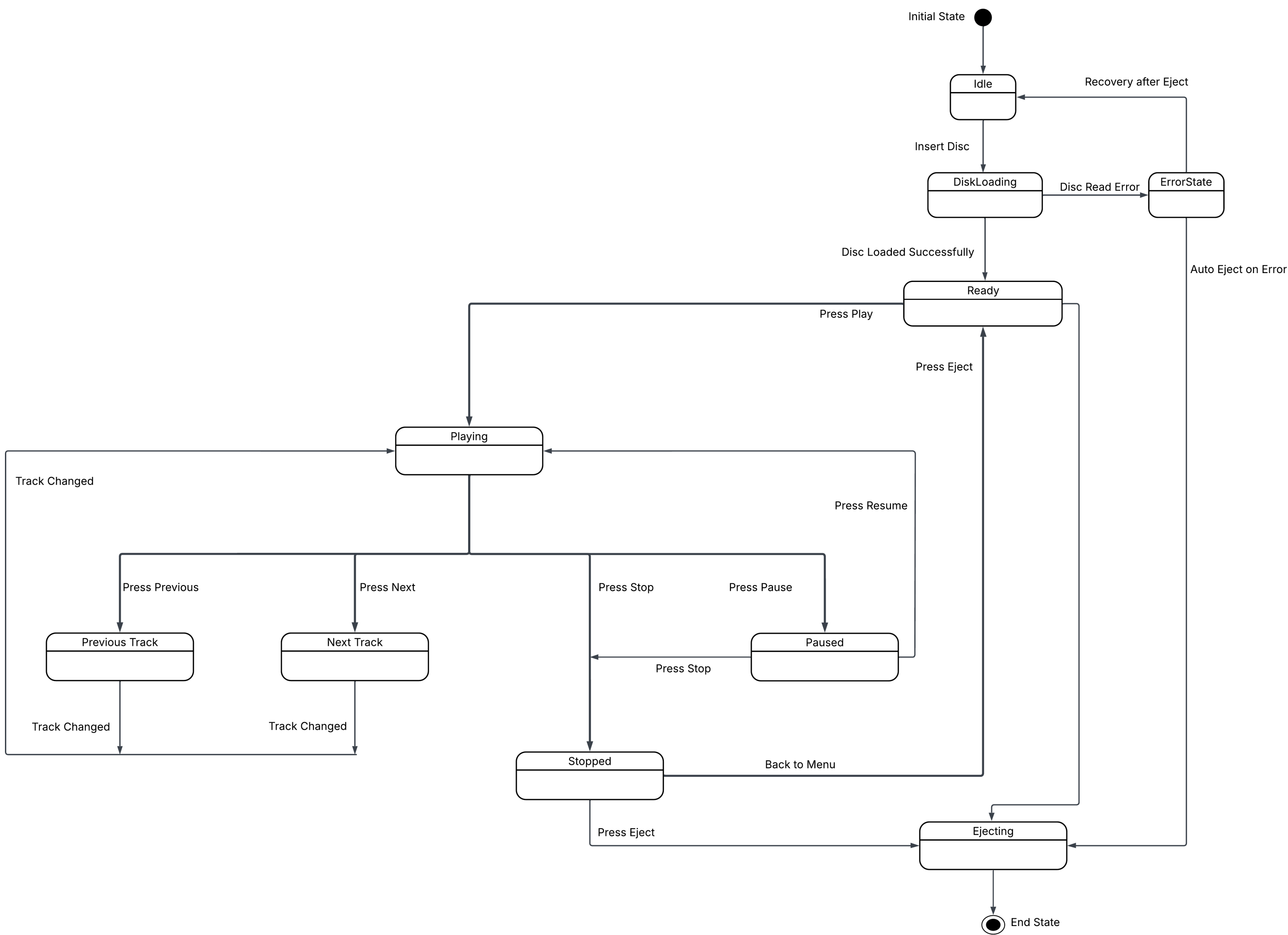
Explanation:

1. Initial State – Idle

➢ The system begins in the **Idle** state, which represents the CD player being powered on with no disc inserted.

2. Disc Handling

➢ Insert Disc: When a user inserts a disc, the player transitions from the **Idle** state to **DiskLoading**.

➢ Successful Load: If the disc is successfully read, the player moves to the **Ready** state, indicating readiness for playback else it moves to **ErrorState** indicating Disc Read Error.

3. Playback Control

Once the CD is successfully loaded and the system is in the **Ready** state, the following playback operations are available:

➢ **From Ready State:**

▪ Start Playback: The user can initiate playback by pressing the Play button.

▪ Eject Disc: If the user chooses to remove the disc instead, pressing Eject transitions the system to the **Ejecting** state.

➢ **During Playback:** While in the Playing state, the user can control playback with the following options:

▪ Pause Playback: Pressing the Pause button will temporarily halt the playback.

▪ Resume Playback: From the Paused state, pressing Resume continues playback.

➢ **Track Navigation:**

▪ Next Track: The user can navigate to the next track by pressing the Next button.

▪ Previous Track: Similarly, the user can move to the previous track using the Previous button.

➢ **Stopping Playback**

▪ From Playing State: Playback can be stopped directly from the Playing state by pressing the Stop button.

▪ From Paused State: If paused, playback can also be terminated using the Stop button.

4. Stop and Menu Navigation

➢ After the system enters the **Stopped** state following the stop command, the user has two choices:

➢ Return to Menu: The player can return to the **Ready** state, allowing the user to select a different track or action.

➢ Eject Disc: If the user wishes to remove the disc, pressing Eject transitions the system to the **Ejecting** state.

5. Ejecting the Disc

➢ When the user chooses to eject the disc (either from the Ready or Stopped states), the system transitions into the **Ejecting** state:

➢ This transition indicates that once the disc is physically removed from the player, the system returns to the **Idle** state, ready for a new disc to be inserted.

6. Error Handling and Recovery

➢ The system includes comprehensive error detection at key stages, ensuring robust operation. Specific failure points and their transitions to the Error state are as follows:

Component	Error Transition
DiskLoading	DiskLoading → ErrorState: Disc Read Error
Error Handling	ErrorState → Ejecting: Auto Eject on Error
Error Recovery	ErrorState → Idle: Recovery after Eject

Q3. Draw a detailed state machine models of the control software for: A telephone answering machine which records incoming messages and displays the number of accepted messages on an LED display. The system should allow the telephone owner to dial in, type a sequence of numbers (identified as tones) and have the recorded messages replayed over the phone.
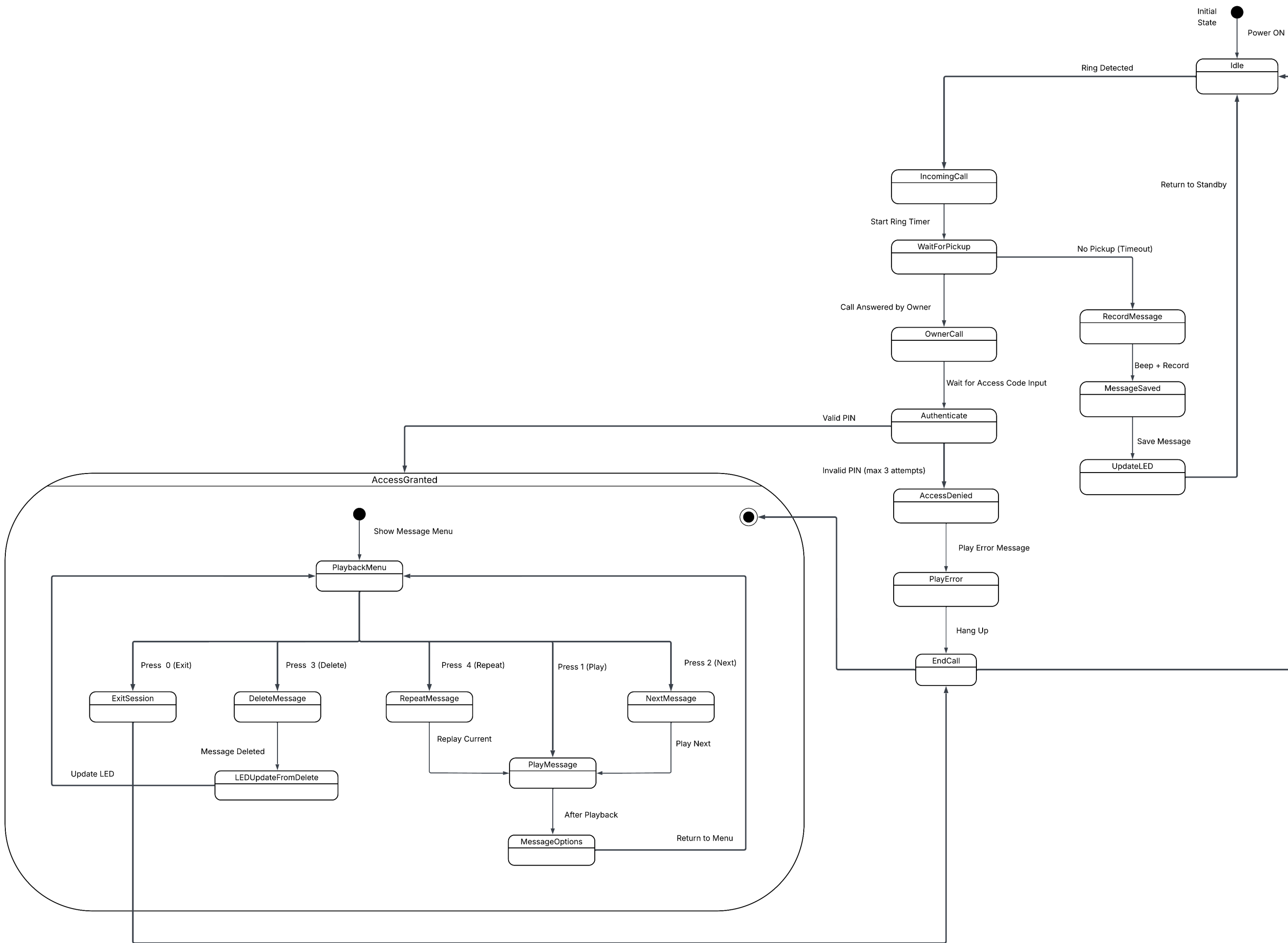
Explanation:

1. Initial State - Idle

➤ The system begins in the **Idle** state upon powering on, awaiting either an incoming call or owner interaction.

2. Incoming Call Handling

➤ When a ring is detected, the system transitions from the Idle state to **IncomingCall**, and a ring timer is started to monitor whether the call is answered.

       Idle   → IncomingCall: Ring Detected

       IncomingCall → WaitForPickup: Start Ring Timer

3. No Pickup

➤ If the call is not answered within the specified timeout duration, the system transitions to **RecordMessage** to record the caller's voice message. After recording, it proceeds to the **MessageSaved** state, where the message is saved, the LED display is updated in the **UpdateLED** state to reflect the new message count, and the system returns to the **Idle** state.

       WaitForPickup   → RecordMessage: No Pickup (Timeout)

       RecordMessage   → MessageSaved: Beep + Record

       MessageSaved   → UpdateLED: Save Message

       UpdateLED   → Idle: Return to Standby

4. Owner Picks Up

➢ If the call is answered by the telephone owner before the timeout, the system proceeds to the **OwnerCall** state and prompts for a PIN to authenticate the owner:

WaitForPickup → OwnerCall: Call Answered by Owner

OwnerCall → Authenticate: Wait for Access Code Input

5. Authentication Process

➢ If the owner enters an invalid PIN for all three attempts, the system transitions to the **AccessDenied** state, where an error message is played before ending the call and returning to the **Idle** state.

Authenticate → AccessDenied : Invalid PIN (max 3 attempts)

AccessDenied → PlayError : Play Error Message

PlayError → EndCall : Hang Up

EndCall → Idle

➢ If the owner enters the correct PIN within a maximum of three attempts, access is granted, and the user is transitioned into the **AccessGranted** state for message playback and management session.

Authenticate → AccessGranted: Valid PIN

6. Owner Session: Playback and Management

➢ Once the telephone owner has been successfully authenticated, the system transitions into a composite state called **AccessGranted**, which represents the session in which the owner can interact with the stored messages. During this session, the owner is presented with a **PlaybackMenu**, where message management options are available via DTMF (Dual-Tone Multi-Frequency) tones entered through the telephone keypad.

The options available in the **PlaybackMenu** are:

- Press 1: Play the current message.

- Press 2: Move to the next message.

- Press 3: Delete the current message.

- Press 4: Repeat the current message.

- Press 0: Exit the session.

Each of these inputs triggers a specific transition within the system:

- From the initial sub-state, the system enters the **PlaybackMenu**.

- Pressing 1 transitions the system to **PlayMessage**.

- Pressing 2 transitions the system to **NextMessage**.

- Pressing 3 transitions the system to **DeleteMessage**.

- Pressing 4 transitions the system to **RepeatMessage**.

- Pressing 0 transitions the system to **ExitSession**.

➢ After a message has been played, the system provides further options through the **MessageOptions** state, allowing the user to return to the main menu for further actions.

➢ If the user chooses to delete a message, the system transitions to the **LEDUpdateFromDelete** state, where the LED display is updated to reflect the change in message count. After this, the system returns to the **PlaybackMenu**.

➢ Once the user presses 0 to **exit** the session, the system moves to the **EndCall** state, exits the composite state, and finally returns to the **Idle** state, indicating that the session has been concluded.