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??????: J3300

??????????? ???????: https://github.com/Vladislavim/Engine_AID

2026 ?.

1. ???? ? ?????????? ??????

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? ?????? ????????????? ??????? ?????????? ?????????? ????? Application, ???????
????????? ????, ?????? deltaTime, ??????? ??????????, ????????? RenderAdapter ? ?????????
????????? ?????????. ????????????? ????????? ????????? ????? ? ?????????? ? ???? ???
?????????? ???????? ? ?????? deltaTime.

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? ?????????????, ?????? ? ?????????? ?????????? (????? Application);

? ??????? ??????? ???? ? ???????? deltaTime ????? std::chrono;

? ??????? ?????????: Loading, Menu, Gameplay;

? ??????????? ??????? ? ???????? deltaTime ? ??????? ? ???? logs/app.log;

? ??????? ??????? (IRenderAdapter) ? ?????????? ?? ???? raylib;

? ????????? ????????? ????????? (???????) ? ????;

? ?????????? ????????: ???????, ??? (???????), ??? (???????), Esc/Enter/1/2/3 ??? ?????????.

2. ???????? ????? ?????????? ???????

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????????? ? ??????? ??????. ??????? ????????? ???????? ????????? ????????? ???????
(????????, ????, ??????? ?????). ????????? ????? ?? ??????????? IRenderAdapter, ??? ?????????
???????? ??????????? ?????????? ??? ????????? ???????? ??????. ????????? ?????? Logger
???????? ?? ??????????????, ? InputController ? ?? ????????? ????? ? ????????? ??????????
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? src/core/Application.* ? ?????????????, ??????? ????, ????? ?????????, ?????????? ??????;

? src/core/GameState.h ? src/core/States.* ? ??????? ????????? ????????? ? ??????????
?????????;

? src/core/Logger.* ? ??????????? ? ??????? ? ????;

? src/render/IRenderAdapter.h ? ????????? ?????????;

? src/render/RaylibRenderAdapter.* ? ?????????? ???????? ?? raylib;

? src/game/InputController.* ? ????????? ??????????/???? ? ??????? ????????? ??????????
???????.

3. ???????? ???????? ???????? ?????? ????

??????? 1. ????????? ???????? ??????????

????: src/render/IRenderAdapter.h

```
class IRenderAdapter {
public:
    virtual ~IRenderAdapter() = default;
```

```cpp
    virtual bool initialize(int width, int height, const std::string& title) = 0;
    virtual bool windowShouldClose() const = 0;
    virtual InputFrame pollInput() = 0;
    virtual WindowSize getWindowSize() const = 0;

    virtual void beginFrame(const ColorRGBA& clearColor) = 0;
    virtual void drawPrimitive(const PrimitiveTransform& transform, const ColorRGBA& color) = 0;
    virtual void drawTextLine(const std::string& text, int x, int y, int fontSize, const ColorRGBA&
    virtual void endFrame() = 0;
    virtual void shutdown() = 0;
};
```

??????? 2. ??????? ??????? ???? ? ?????? deltaTime

????: src/core/Application.cpp

```cpp
while (running_ && !renderer_->windowShouldClose()) {
    const auto now = std::chrono::steady_clock::now();
    const std::chrono::duration<double> dtDuration = now - lastFrameTime_;
    lastFrameTime_ = now;

    double dt = dtDuration.count();
    if (dt > 0.25) {
        dt = 0.25;
    }

    dtLogTimer_ += dt;
    if (dtLogTimer_ >= 0.5) {
        std::ostringstream ss;
        ss << std::fixed << std::setprecision(4) << "deltaTime=" << dt;
        Logger::instance().info(ss.str());
        dtLogTimer_ = 0.0;
    }

    const InputFrame input = renderer_->pollInput();
    scene_.windowSize = renderer_->getWindowSize();
    handleGlobalStateSwitch(input);

    if (state_) {
        if (auto next = state_->update(dt, input, scene_); next.has_value()) {
            changeState(*next);
        }
    }

    renderer_->beginFrame(clearColorForState());
    if (state_) {
        state_->render(*renderer_, scene_);
    }
    renderer_->endFrame();
}
```

??????? 3. ????????? ????? ? ?????? deltaTime

????: src/game/InputController.cpp

```cpp
void InputController::updateFromInput(const InputFrame& input, double dt,
                                      PrimitiveTransform& transform, WindowSize windowSize) {
    if (input.mouseLeftPressed) {
        scaleAroundCenter(transform, windowSize, 1.08f);
    }
    handleMouseActions(input);

    const float moveSpeed = 240.0f;
    const float moveStep = static_cast<float>(dt) * moveSpeed;

    if (input.up) transform.position.y -= moveStep;
    if (input.down) transform.position.y += moveStep;
    if (input.left) transform.position.x -= moveStep;
```
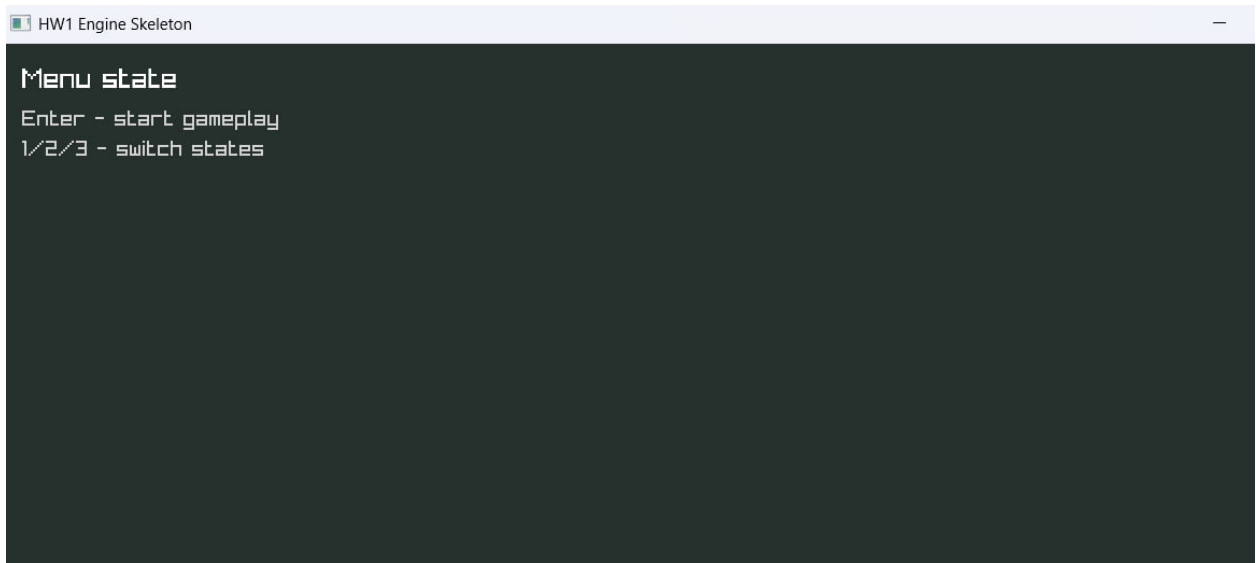
```cpp
    if (input.right) transform.position.x += moveStep;

    const float sLerp = std::min(1.0f, static_cast<float>(dt) * 8.0f);
    const float rLerp = std::min(1.0f, static_cast<float>(dt) * 10.0f);

    transform.scale += (targetScale_ - transform.scale) * sLerp;
    transform.rotationDeg += (targetRotation_ - transform.rotationDeg) * rLerp;
}
```
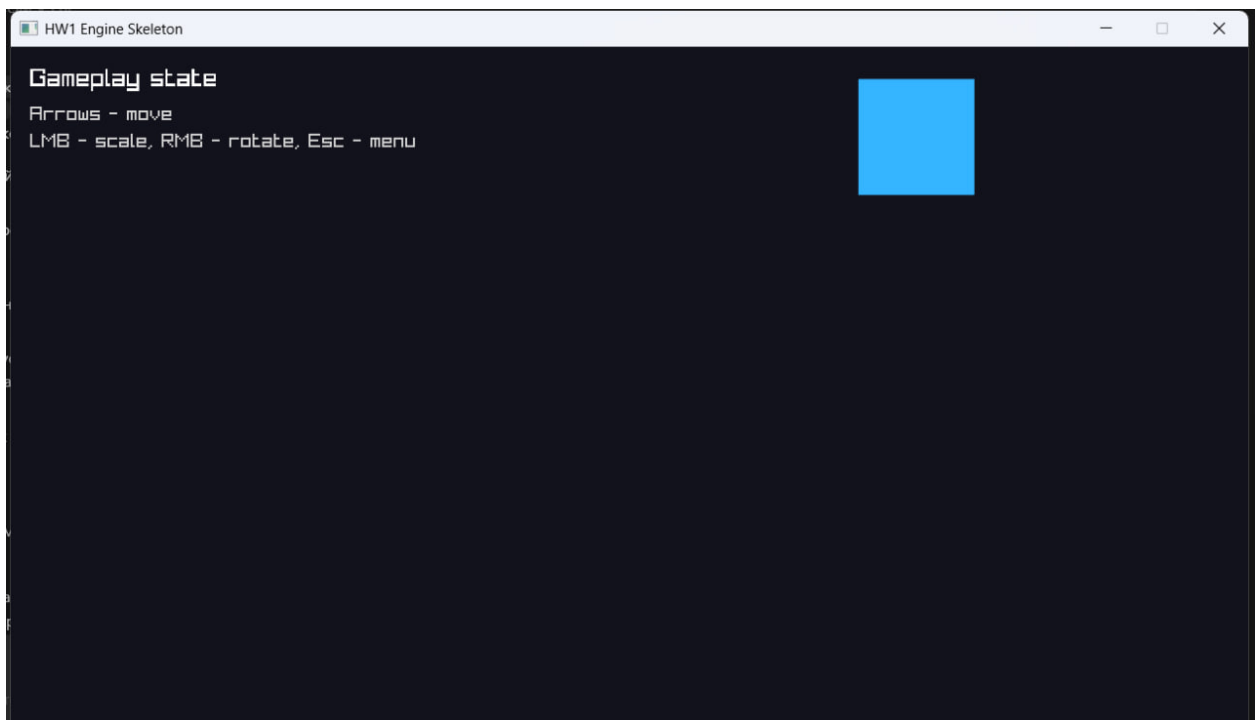
4. ????????? ???????? ??????????

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??????? 2 ? ????????? Gameplay ? ???????? ?????????? (?????????).

5. ???????? ????????????????

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6. ??????

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7. ?????????? ? ??????

1. ??????????? ? ???????? ?????: https://github.com/Vladislavim/Engine_AID
2. ??????????????? ???? ??????: CMakeLists.txt
3. ????????? ??????????: docs/screenshots/menu.jpg, docs/screenshots/gameplay.jpg
4. PDF-?????: docs/REPORT_PZ1_Imanakov_VP_J3300.pdf