A 'Hello World' for the LambdaTable

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This is a simple Electro application for the LambdaTable. By continuously reading in data from the tracker, the program draws markers for each active puck on the table, accurately representing their position and orientation. In the following sections, each bit of code is described, and at the end the program is presented in its entirety. Instructions are provided on how to turn on the LambdaTable and run your code. Refer to the last page for any referenced diagrams.

```
new_x,
new_y,
new_a  = 0, 0, 0

myhost = "*"
myport = 7000
udp    = {}

device = {}
```

These are global variables which will be used in later subroutines. The **`new_*`** variables refer to the coordinates of a puck, and are initialized here. **`myhost`**, **`myport`**, and **`udp`** are needed to set up a UDP data stream from the tracking cluster of the LambdaTable. The variable **`device`** is initialized to be an empty table. It will later hold an entry for each puck on the table.

```
function create_scene()
    camera = E.create_camera(E.camera_type_orthogonal)
    pivot  = E.create_pivot()

    E.parent_entity(pivot, camera)

    dsp_x0, dsp_y0, dsp_w, dsp_h = E.get_display_union()

    E.set_entity_position(pivot, dsp_x0 + dsp_w/2, dsp_y0 + dsp_h/2, 0)

    brush_line = E.create_brush()
    brush_fill = E.create_brush()

    E.set_brush_color(brush_line, 0.2, 0.2, 0.5, 1.0)
    E.set_brush_color(brush_fill, 0.8, 0.8, 0.8, 1.0)
end
```

This function sets up the scene graph with the camera as the root, and a pivot as its only child. (**Fig 1** shows the complete hierarchy of objects. The device objects will be explained later on.) **`dsp_x0`**, **`dsp_y0`**, **`dsp_w`**, **`dsp_h`** are initialized to the position, width, and height of the pixel size of the LambdaTable display. In the coordinate system of Electro, the origin is in the center of the viewable area, with **`dsp_x0`** and **`dsp_y0`** being the bottom left corner. This can be seen in **Fig 3**. In the next line, the position of **`pivot`** is set to (0,0), in the coordinate system of the camera. Then the brushes for the puck markers are initialized.

```
function mark_sprite(id)

    local id_string  = E.create_string(string.format("%d", id))
    local pivot      = E.create_pivot ()

    E.set_entity_scale   (id_string, 32, 32, 32)
    E.set_entity_position(id_string, 96, 96, 0 )

    E.set_string_line    (id_string, brush_line)
    E.set_string_fill    (id_string, brush_fill)

    E.parent_entity(id_string, pivot)

    return pivot
end
```

Here, the labels for each puck are set up. The LambdaTable distinguishes each puck from one another, giving them ID's starting at 1 up to the number of devices it is configured for. Therefore, each marker will be labeled with the appropriate string object.

```
function make_sprite(filename, trans, unlit )
    local image = E.create_image(filename)
    local brush = E.create_brush()

    E.set_brush_flags(brush, E.brush_flag_transparent, trans)
    E.set_brush_flags(brush, E.brush_flag_unlit,       unlit)

    E.set_brush_color(brush, 1.0, 1.0, 1.0, 1.0)
    E.set_brush_image(brush, image)

    local sprite = E.create_sprite(brush)
    E.set_entity_position(sprite, -128, -128, 0)

    return E.create_sprite(brush)
end
```

This function creates a sprite in the following sequence. First, an image is created from the input **`filename`**. Then a brush is created, using the image as its texture map. Finally, a sprite is created using the brush.

```
function show_device(dev, type)
    for i=1, 3 do
       E.set_entity_flags(dev[i], E.entity_flag_hidden, not (i == type))
    end
end
```

In **`show_device`**, the **`dev`** parameter is a table holding sprites corresponding to different marker states. One puck may have three different sprites associated with it – the default, one for a left button press, and one for a right button press. **`type`** is a number from the tracker that indicates which state the puck is in, and therefore which sprite should be displayed.

```
function do_timer(dt)

    local socketEmpty = false
    local dgram
    local update      = false

    repeat
       poll = udp:receivefrom(60)
       if poll == nil then
           socketEmpty = true
       else
           dgram = poll
       end
```

```
    if dgram then
        if tonumber(string.sub(dgram,  1, 10)) == 2 then
            update = true

            msg_id    = tonumber(string.sub(dgram, 11, 20))
            msg_xpos  = tonumber(string.sub(dgram, 21, 30))
            msg_ypos  = tonumber(string.sub(dgram, 31, 40))
            msg_angle = tonumber(string.sub(dgram, 41, 50))
            msg_type  = tonumber(string.sub(dgram, 51, 60))

            if not device[msg_id] then
                local id   = msg_id
                device[id] = {}

                device[id][1] = make_sprite("marker.png",       true, true)
                device[id][2] = make_sprite("marker_left.png",  true, true)
                device[id][3] = make_sprite("marker_right.png", true, true)
                device[id].id = mark_sprite(id)
                device[id].pv = E.create_pivot()

                E.parent_entity(device[id][1], device[id].pv)
                E.parent_entity(device[id][2], device[id].pv)
                E.parent_entity(device[id][3], device[id].pv)
                E.parent_entity(device[id].id, device[id].pv)

                E.parent_entity(device[id].pv, pivot)
            end

            show_device(device[msg_id], msg_type)

            new_x = msg_xpos * dsp_w + dsp_x0
            new_y = msg_ypos * dsp_h + dsp_y0
            new_a = msg_angle

            local x, y, a = new_x, new_y, new_a

            E.set_entity_rotation(device[msg_id].pv, 0, 0, a)
            E.set_entity_position(device[msg_id].pv, x, y, 0)

        end
    end
    until socketEmpty

    return update
end
```

As stated in the Electro documentation, if idling is enabled, the **`do_timer`** callback is invoked regularly. In this function, the udp socket object is continuously polled, and each received datagram is parsed into **`msg_id, msg_xpos, msg_ypos, msg_angle`**, and **`msg_type`**. Then, if the device table does not have an existing entry for the particular puck corresponding to **`msg_id`**, an entry is created, resulting in a graph such as **Fig 1.** Otherwise, the **`show_device`** subroutine is called to update which markers should be displayed. The position and rotation of the markers are also updated. Note that the received position values will fall between 0 and 1, as shown in **Fig 2.** Angle values should be interpreted with 0 degrees being 'north', 90 degrees being 'west', and so on.

```
function do_start()
    create_scene()

    E.set_typeface("VeraBd.ttf", 0.0001, 0.03125)

    -- Open port to listen for track data

    E.print_console("Binding to host '" .. myhost ..
                    "' and port " .. myport .. "...\n")

    udp, err = socket.udp()
```

```
    ret, err = udp:setsockname(myhost, myport)
    udp:settimeout(.001)
    myip, myport = udp:getsockname()

    E.print_console("Waiting packets on " .. myip ..
                    ":" .. myport .. "...\n")
    E.enable_timer(true)
end
```

do_start is the 'main' function of the program. It starts by calling **create_scene** and setting up the scene graph. Then it sets up UDP communication with the LambdaTable tracker. The **socket.udp()** function creates a UDP socket object. **setsockname** binds the UDP object to a local address. All of these functions are part of the LuaSocket library, documented at **http://www.cs.princeton.edu/~diego/professional/luasocket/.**
Finally, idling is enabled, which ensures that the **do_timer** function will be called.

Full source of ui-test.lua

```
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new_a  = 0, 0, 0

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device = {}


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    dsp_x0, dsp_y0, dsp_w, dsp_h = E.get_display_union()

    E.set_entity_position(pivot, dsp_x0 + dsp_w/2, dsp_y0 + dsp_h/2, 0)

    brush_line = E.create_brush()
    brush_fill = E.create_brush()

    E.set_brush_color(brush_line, 0.2, 0.2, 0.5, 1.0)
    E.set_brush_color(brush_fill, 0.8, 0.8, 0.8, 1.0)
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    E.parent_entity(id_string, pivot)

    return pivot
end

function make_sprite(filename, trans, unlit )
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    local brush = E.create_brush()

    E.set_brush_flags(brush, E.brush_flag_transparent, trans)
    E.set_brush_flags(brush, E.brush_flag_unlit,       unlit)
```

```
    E.set_brush_color(brush, 1.0, 1.0, 1.0, 1.0)
    E.set_brush_image(brush, image)

    local sprite = E.create_sprite(brush)
    E.set_entity_position(sprite, -128, -128, 0)

    return E.create_sprite(brush)
end

function show_device(dev, type)
    for i=1, 3 do
       E.set_entity_flags(dev[i], E.entity_flag_hidden, not (i == type))
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function do_timer(dt)

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           dgram = poll
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    if dgram then
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                device[id][3] = make_sprite("marker_right.png", true, true)
                device[id].id = mark_sprite(id)
                device[id].pv = E.create_pivot()

                E.parent_entity(device[id][1], device[id].pv)
                E.parent_entity(device[id][2], device[id].pv)
                E.parent_entity(device[id][3], device[id].pv)
                E.parent_entity(device[id].id, device[id].pv)

                E.parent_entity(device[id].pv, pivot)
            end

            show_device(device[msg_id], msg_type)

            new_x = msg_xpos * dsp_w + dsp_x0
            new_y = msg_ypos * dsp_h + dsp_y0
            new_a = msg_angle

            local x, y, a = new_x, new_y, new_a

            E.set_entity_rotation(device[msg_id].pv, 0, 0, a)
            E.set_entity_position(device[msg_id].pv, x, y, 0)

        end
    end
    until socketEmpty

    return update
```

```
end

function do_start()
    create_scene()

    E.set_typeface("VeraBd.ttf", 0.0001, 0.03125)

    -- Open port to listen for track data

    E.print_console("Binding to host '" .. myhost ..
                    "' and port " .. myport .. "...\n")

    udp, err = socket.udp()
    ret, err = udp:setsockname(myhost, myport)
    udp:settimeout(.001)
    myip, myport = udp:getsockname()

    E.print_console("Waiting packets on " .. myip ..
                    ":" .. myport .. "...\n")
    E.enable_timer(true)
end

do_start()
```

Using the LambdaTable

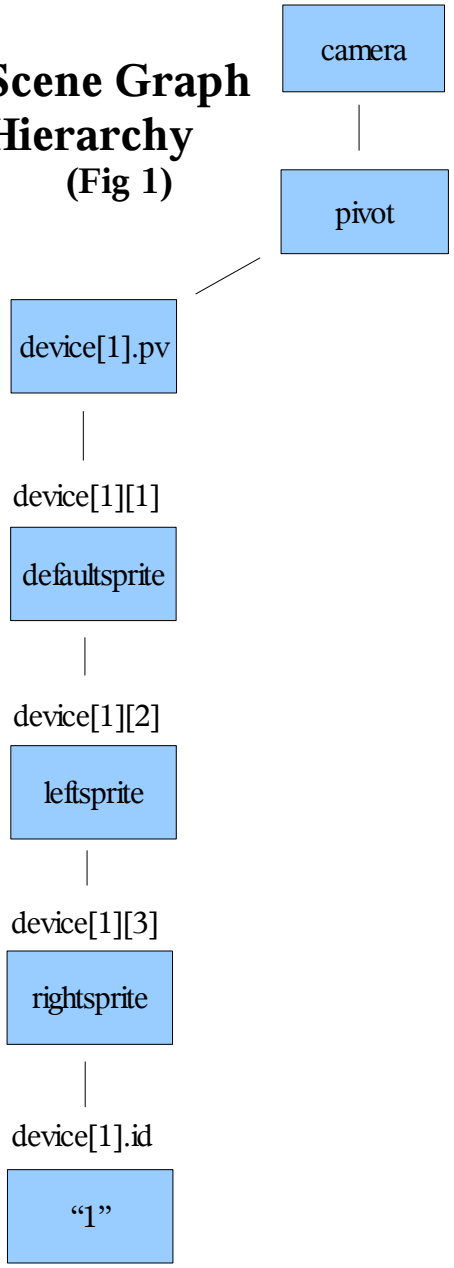
To test any applications on the LambdaTable, you need to first have an account. Speak with your professor about this. Once you have your account, refer to http://www.evl.uic.edu/cole/usingtable/ to help you set up your work environment and operate the table.

To run your application, it's convenient to write a short script. Here's an example...

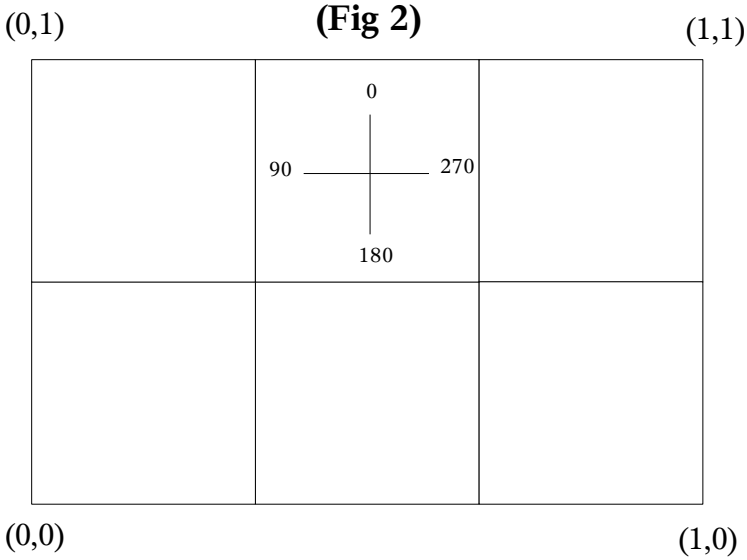
```
#!/bin/sh
cd /home/evl/cfalk2/electro
/home/evl/public/electro/electro-table ui-test.lua -m
```

Diagrams

Scene Graph Hierarchy (Fig 1)



LambdaTable Coordinate System (Fig 2)



Electro Coordinate System with LambdaTable dimensions (Fig 3)