S2 Embedded Systems Weeks 3 and 4 Lab – Protocols and State Machines

Lab Report

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Assignments

A-Design the communication protocol and add this to your report. Things to consider:

•Who is master/slave.

•How can I send commands and data.

•Answers you expect on commands and data send.

•If something goes wrong: what happens?

B-Implement the protocol in both Arduino's. The implementation needs to meet the following conditions:

•Use state diagrams (add them to your documentation)

•Use 2 state machines: one handling the communication and one handling the LED switching.

C-Test your implementation:

•Under normal conditions

•If you disconnect the communication between the Arduino's

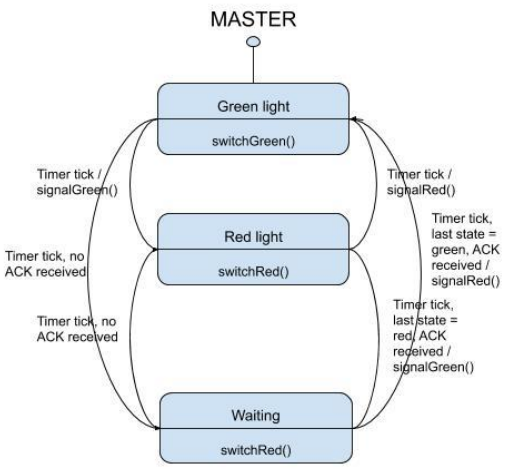
•What happens if the connection is reconnected?

Protocol description

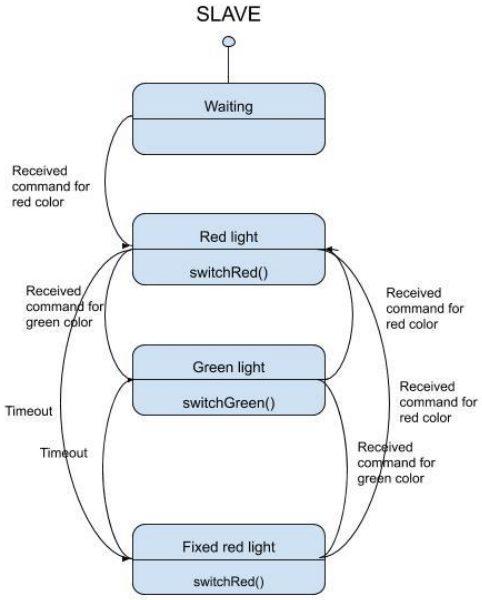
Since we use two Arduinos, one of them will be assigned a master role and the other one - the slave role. UART is used for communication between them, so they are wired with 4 wires – one for VCC to VCC for powering the slave, one for ground and the other two connect the RX to the TX of the other device. The commands are sent from the master to the slave – one command every 3 seconds, which tells the slave which traffic light should be on and off. An acknowledgement is expected from the slave, to make sure the command has been received.

An acknowledgement to the acknowledgement is unnecessary, since the slave already expects a command every 3 seconds. If a command is not received in that interval, the slave Arduino will turn the traffic light to red, to ensure the safety of the vehicles and no acknowledgement will be sent. If the acknowledgement that is expected is not received, then the master will also turn the red light on, so that no cars can collide with such, who may be coming from the other side.

State diagrams



signalRed()/signalGreen() - sends the command for the appropriate color to the slave
switchRed()/switchGreen() - switches the traffic light to the other color, saves the current state and resets the timer
timer = 3s
timeout = 4s



switchRed()/switchGreen() - switches the traffic light to the other color, sends an acknowledgement and resets the timeout

Tests

Under normal conditions, the traffic lights of both Arduinos always show the opposite light, so that the cars from the two sides take turns in passing through the street. If the connection between the 2 Arduinos is disrupted, both of them turn on the red light and no one can pass. When the connection is restored, the traffic lights will begin working normally again as soon as the interval resets (3s).