RateController (RC) is an add-on app that works with AgOpenGPS (https://github.com/farmerbriantee/AgOpenGPS/) for product application rate control.

RC Installation

1. Go to https://github.com/SK21/AOG_RC
2. Under Releases click latest.
3. Download RateControllerApp.zip
4. Extract the file to a folder of your choice.
5. Find and run RateController.exe

Module Installation

There are various pcbs for the Nano, Teensy, ESP8266 and ESP32. They can be installed with the arduino IDE or PCBsetup. https://github.com/SK21/PCBsetup . The Nano and Teensy need a serial connection. ESP8266 can use serial or OTA wifi. The ESP32 can update from its hotspot web page.

Connecting to a module

1. Upload the firmware.
2. Connect an Ethernet cable between the module and the tablet/router/network switch.
3. In the rate app go to Menu – Module Config – Network.
4. Select the Local IP.
5. Save the changes with the down arrow in the lower right of the dialog.
6. Press the up arrow in the centre of the dialog to send the subnet setting to the module.
7. Go to Menu – Products – Product 1.
8. Select the Options tab and check that the Module ID is 0.
9. The Mod icon should turn green when connected.
10. Check connection on the Comm Diagnostics page. The Subnet Address should be the one selected in step 4. The Ethernet tab should show information being sent and received.

RC will start with the standard screen. If AOG is running a green AOG icon will be displayed. If the current product module is connected there will be a green MOD icon. A blue MOD icon means the module is sending but not receiving. This usually means the subnet is incorrectly set. Click on either the AOG icon or the MOD icon to minimize the screen. Left and right arrows allow you to show 1 of 4 products, 1 of 2 fans or a summary screen. When displaying a product clicking on the status lines can show multiple values. Click on the '?' symbol at the top of the page and then click on an item on the screen to show help for that item. Clicking on the gear icon displays the menu.

Menu - Products/Fans - Rate

1. Product name
2. Control type
    - Standard Valve – use a valve to control rate
    - Combo Close – use a valve to control rate and also used for on/off
    - Motor – vary the speed of a motor to control rate
3. Quantity
    - units for the product. Ex: lbs, kgs, litres
4. Coverage
    - area units – acres, hectares
    - time units – minutes, hours. AOG not required when using these.
5. Sensor counts/unit
    - the number of counts or pulses for one unit of product. Ex: 100 pulses/litre
6. Density
    - Ex: lbs/cu. Ft or kgs/cu. M
7. Base rate
    - the rate used for the majority of the field
8. Alt. rate (%)
    - a percent value of the base rate. Ex: 120 would mean 1.2 X the base rate is applied. This is selected on the standard screen by clicking on 'Target Rate'. The screen will show 'Target Rate Alt' and will apply at 1.2 X the base rate.
9. Tank size
    - kgs, litres, lbs etc.
10. Tank starting
    - the amount in the tank at the start of the job. Clicking on the button will reset the starting amount to the full tank capacity.
11. Coverage reset
    - zero's out the accumulated coverage
12. Quantity reset
    - zero's out the accumulated quantity applied

Menu – Products/Fans – VR

For use with a variable rate map that sends % rate based on map colour.

1. Channel
   * colour for %
2. Maximum Rate
   * rate applied at 100 %
3. Minimum Rate
   * rate applied at 1 %

Menu - Products/Fans - Control

1. Proportional
   * has a direct ratio to rate error. A higher proportional value results in a greater response to rate error.
2. Integral
   * accumulates errors to provide an offset to the rate adjustment. A higher integral increases the offset due to past rate errors.
3. Derivative
   * looks at past errors in the system and calculates the slope of those errors to predict future error values. It has dampening affect on rate control.
4. PWM Maximum
   * the maximum power sent to the valve/motor when rate error is large. When the error gets less than 20% the rate of adjustment is decreased to 75% of normal. When the error gets below 4% no further rate adjustment is made.
5. PWM Minimum
   * the minimum power sent to the valve/motor to begin adjustment
6. PID Scaling
   * Divisor sets the resulting value size
   * P example shows the effect of the scaling
7. Pressing on the button with the arrow and hard drive enters the default values for these settings.
8. Pressing on the graph button shows a tuning graph to help with adjusting the settings.

Menu - Products/Fans - Options

1. Sensor Location
   * Module ID - the number of the attached rate module (0-7)
   * Sensor ID – the number of the rate sensor in the module (0-1)
   * the indicator icon will turn green when connected.
2. Rate Method
   * time for one pulse – if the time for each pulse is greater than 50 ms then the length of a single pulse is used to determine the rate.
   * average time/pulse – if the time for each pulse is less then 50 ms then an average of 12 pulses is used to determine the rate.
3. On Screen
   * whether to show the product on the Large screen
   * click to change
4. Constant UPM
   * application rate does not vary with the number of sections on or off
5. Default Product
   * the first product shown at start-up.
6. Bump Buttons
   * show the up-rate down-rate buttons on the Large screen instead of the product
7. Minimum UPM
   * the lowest Units Per Minute (UPM) applied regardless of ground speed.
8. Off-rate Alarm
   * the maximum rate error above which an alarm sounds

Menu - Products/Fans - Diagnostics

1. UPM Applied
   * the current Units per Minute being applied
2. UPM Target
   * the target UPM calculated from the Base rate
3. Error %
   * the application rate error
4. PWM
   * the Pulse width modulation. Varies voltage to the valve/motor.
5. Counts/Rev
   * the number of pulses or counts per revolution of the rate meter
6. RPM
   * speed of the rate meter calculated from Counts/Rev and sensor pulses
7. Ground speed
   * reported ground speed from AOG
8. Working Width
   * the total width of the sections of the implement that are on
9. Coverage/Hr
10. Wifi Signal
11. Sections

Menu – Sections

Enter the number of sections of the implement. Each section has a width and a switch number that controls it. There can be up to 128 sections. Sections can also be entered as zones as in AOG. When the section count is changed in AOG it also changed in RC.

Menu – Relays

There can be up to 16 relays per module and 8 modules for a total of 128 relays. Each relay is assigned a section number. Each relay can be do different tasks:

1. Section
    - relay is controlled by section switch
2. Slave
    - relay is on when any section relay is on and off when all section relays are off
3. Master
    - relay is on when any section relay is on and turns off before section relays turn off
4. Power
    - on all the time
5. Invert Section
    - relay is on when section is off
6. Hydraulic Up
7. Hydraulic Down
8. Tram Right
9. Tram Left
10. Geo Stop

Menu – Comm

The rate modules can be connected to RC through a serial/usb connection. A switch box can also be connected by serial/usb. These will auto reconnect at startup.

Menu – Calibrate

This screen is used to get an accurate pulses/unit value for a product. The idea is to simulate driving at field speed with the meter roller turning at a consistent rpm each time the calibration is done.

Calibration steps:

1. enter ground speed
2. set calibration meter speed (rpm)
    - start with Master switch off
    - switch product on with the power button
    - enter initial base rate
    - enter initial Cal Factor
    - press start, RC attempts to adjust flow/rate to target
    - if successful meter speed is locked
    - press stop
3. set Cal Factor (pulses/unit)
    - start with Master switch off
    - press start, turn Master switch on and let run to get an adequate sample amount
    - press stop and enter measured amount. Cal Factor is calculated.
    - press save to record new values
4. options to start over
    - if RC is not successful in locking the meter speed adjust initial Cal Factor, ground speed, PWM minimum, PWM maximum or machine metering drive range. Start step 2 again.
    - to redo the meter speed the lock button can be pressed to unlock. RC will then attempt to find a new meter speed when step 2 is redone.
    - to start from a previously saved setting the lock button can be pressed to lock. Then continue with step 3.

Menu – Modules – Network

Select the subnet the tablet is connected to, save, and then sent it to the modules.

Menu – Modules – Config

1. Module ID
   * 0 - 7
2. Sensor Count
   * 0 - 1
3. Wifi Serial Port
   * on some pcbs a wifi unit can provide connection to RC. This is the port the wifi unit connects to the main micro-controller on.
4. Relay Control
   * the method of connecting to the relays from the micro-controller.
5. Relay on High
   * whether the relay is enabled with a low signal or a high signal.
6. Flow on High
   * whether the flow is enabled with a low signal or a high signal.
7. Hard drive and Up arrow
   * load default values. Pressing the '?' on this button will show a list of pcb settings.
8. Up arrow
   * send to module and restart the module

Menu – Modules – Pins

This is a list of the micro-controller pin numbers assigned various functions.

Menu – Modules – Relays

Pin numbers assigned to each relay.

Menu – Modules – Wifi Client

For use with an ESP32 module to connect in AP mode. In this mode the module provides a hotspot and the tablet connects to it.

Menu – Options – Display – LargeScreen

Instead of displaying the standard screen on start-up, the LargeScreen can be displayed. It can show 4 products and 2 fans. The product display shows bar graphs of the quantity remaining and the current application rate. If the rate is low or high the bar will turn red. On target it is green. Clicking on a product bar graph makes it current and details for the product will be shown. To quickly get to the settings for a product click on the header of the product. The header will be red if the product is not connected to its module. It will be green when connected.

There is an auto button and master button. Right-click (long press) to switch between the two. There is a minimize button to hide the main screen.

Menu – Options - Display – Pressure

Show pressure for the selected sensor.

Menu – Options - Display – Switches

A switch screen can be shown when this option is checked. There is a master switch, auto switch, 4 section switches, rate up and rate down. Each section switch can be assigned multiple sections on the Menu – Sections screen.

Menu – Options - Display – Transparent

Some screens will become transparent when this option is checked. To move the transparent screen right-click (long press) and drag.

Menu – Options – Display – Dual Auto

Show separate switches for auto rate and auto section control.

Menu – Options – Config – Simulate Speed

Simulate ground speed and do not use/require data from AOG.

Menu – Options – Primed Start

Start a simulated product application or prime the booms when tractor is stopped.

1. On time
   * run-time for application in seconds
2. Speed
   * simulated speed
3. Switch Delay
   * the number of seconds to hold the master switch in the ‘ON’ position to start simulation
4. Resume
   * if the tractor starts moving continue with normal application

Menu – Pressure

The pressure screen can receive up to 16 pressure readings. Enter the units/volt and offset for zero. One pressure can be shown on-screen. To enable click the 'Show Pressure' button and select the pressure to be shown.

Menu – Comm Diagnostics

This screen is used to help troubleshoot connection problems. The module reports its ID and firmware version. The PGN time is the communication time between the module and RC. It should be about 0.2 seconds. The Ethernet tab shows the pgns being sent and received. The information can be saved to a text file and is found in 'Documents/RateController'.

Troubleshooting

No Relays:

1. module config for board and relay type
2. subnet set in app, upload to module
3. section count and width set
4. auto off
5. section assigned to relay
6. switch assigned to section
7. if auto on, sensor counts/unit and base rate are needed

No UPM:

1. speed
2. working width
3. sensor control settings
4. aog connected
5. module connected
6. sensor counts/unit
7. base rate
8. pid values sent to the module?
9. control type, is it a valve or motor?