OPERATING MANUAL: RADIO LINKED FLAGS

SYSTEM OVERVIEW

The radio linked flag system is based on concepts and a large amount of work completed by the MySensors.org group. While the main intent of the MySensors system is home automation, the system appears suitable for use to control game play and various devices on the D14 Airsoft field. Extensive customization is included in the resulting system. While the system is NOT intended to be resold, submission of the customized code used in the project will generally NOT be released back to the open source community at this time.

The MySensors.org system implemented at D14 relies on cheap microcontrollers (Arduino NANOs) connected to a low cost RF radio (nRF24L01) which act as "nodes" in a multi-tier star organization. End nodes transmit to repeater nodes, which in turn talk to either the gateway node or other repeater nodes. The gateway connects to a controller, which controls the commands issued to the node. End nodes can move around physically (repeating nodes should not move however) and will reattach to the network. Addressing and routing of the nodes is controlled by the nodes, repeaters and gateway nodes.

Authorization and digital signing of messages is implemented to prevent rogue interference or MITM attacks (either by players or who knows what!). Each node has a hard coded ID number, representing a flag or building or device.

The following manual is intended for qualified personnel only. Operation and deployment of the radio linked flags requires familiarity with the operating modes and options for maximum effectiveness. Your effort in reviewing and practicing with the system, as well as anticipating how adept the players are at following the instructions, will be rewarded with smooth gameplay and maximum player involvement.

What follows is the installation, operation and maintenance guide for this system.

LOCATION OF INSTALLATIONS

The radio-linked flag installation is spread across the D14 playing field. Due to the size of the field (45+ acres) having admin staff keep up to date on flag status (who owns it) or control players (start/stop games) is a significant burden. Flags may have up to 500 meters between them, but are mainly clustered around the town center. Ideally placed, the "comms" building is intended to look like a communications outpost, and in in fact, the ideal location for the gateway and possibly the controller node as well.

CONTENTS

NORMAL OPERATION PROCEDURES

FLAG NODE MODES OF OPERATION

The flag node contains one button, an RGB light and a beeper as the primary means of interacting with players. Generally, players press a button on the flag to advance thru the colors of the flag, or to indicate they are ready to begin gameplay.

The flag has several different "modes" and the light and buzzer vary with each mode:

Flag Mode	Light	Sound
Sleeping	Off	None
Game ON	Solid Green	3- 1 sec beeps, 1 2 sec beep (like a light tree race start)
Standby	Solid Yellow	1 sec beep when mode starts
Two Minute Warning	White/Green alternates twice with 2 sec pause, repeats 3 times.	Beep when white shown, in sync with white light.
Game END	Solid Red	15 second solid tone.
Blind Man/Distress	Red SOS flash	SOS Beep
GREEN CONTROLLED	Green solid, with 1/4s no color every second.	1 beep per second.
TAN CONTROLLED	Orange solid, with 1/4s no color every second	2 beeps together, every second.
BLUE CONTROLLED	Blue Solid, with 1/4s no color every second	3 beeps together, every second.

More stuff here...

STRONG RF EMISSIONS NEAR THE NODES MAY INTERRUPT COMMUNICATIONS. IT IS RECCOMMENDED THAT HIGH POWER RADIOS DOE ONT TRANSMIT NEAR NODES AND OTHER 2.4-2.5GHZ DEVICES (BLUETOOTH, DRONES, WIFI) ARE NOT OPERATED WITHIN SEVERAL FEET OF THE DEVICE.

WARNING. ALWAYS HAVE A BACKUP GAME PLAY PLAN IN CASE THE SYSTEM IS DOWN. SEVERAL DIFFERENT KINDS OF ISSUES CAN AFFECT THE RADIO LINKS, FROM WEATHER TO INTERFERENCE TO TERRAIN AND VEGETATION GROWTH, TO COLORBLIND PLAYERS. BE PREPARED!

INITIAL CONFIGURATION/RECONFIGURATION

Initial configuration or altering the system settings is performed by accessing the programming menu.

PROGRAMMING MENU DETAILS

PROP INTEGRATION NOTE

Props used on the field can be integrated into the system. The expected minimum amount of integration will allow starting or resetting the prop remotely, finding its status, and in some cases remotely disabling or detonating the device. However, in the initial deployment, props will not be incorporated.

FLAG GAME – FLAG CONTROL

Junk junk junk

GAME FLOW

The initial flow of this game is as follows:

1. System blah blah

SYSTEM MAINTENANCE

OVERVIEW

System maintenance includes items such as pre-operation checks, battery charging and replacement, and node replacement. The system is generally built to handle normal use but any time the device is dropped, kicked or knocked over, an inspection of the device should be performed.

Modifying the code operation – aside from the configuration options in the programming menu – is not covered in this manual. The unit uses C++ Arduino style programming language with an Arduino Nano controller and an nRF24L01+ radio device, and does support direct USB connections for reprogramming. Please contact the D14 owners for questions about the program source code or design documentation.

TROUBLESHOOTING NODE CONNECTIVITY

Note that if a node cannot connect at power-up there may be.

Strong RF emissions near the device have been proven to cause undesired operation, including hanging the controller, erroneous entry, etc. It is recommended that RF transmitters are NOT operated within several feet of the device.

If the device display becomes garbled or appears to hang, power the system down with the access key, then power it back on. The last program will be restarted.

If the buzzer or LEDs run continuously, the MOSFET devices may have failed. MOSFET devices typically (eventually) fail as a short circuit. Turn off the node and replace it with a functioning node if a power cycle does not resolve the issue.

OPENING THE NODE CASE

The case should be opened using the....

ALWAYS DISCONNECT ONE OR BOTH OF THE MAIN BATTERY CONNECTORS WHEN PERFORMING SERVICE.

MOSFETS AND SEVERAL COMPONENTS ARE 'GROUND-SWITCHED'. WHICH MEANS THEY RECEIVE CONSTANT POWER FROM THE BATTERY + RAIL, AND GROUND IS SWITCHED BY THE MOSFET DEVICES. THIS MEANS THE MOSFET TABS AND HEAT-SINKS WILL NORMALLY BE RESTING AT +12VDC DURING OPERATION.

BATTERY CHARGING

The on-board solar charging circuit may take several hours due to battery capacity. Battery is considered charged when the voltage reaches 11 VDC. Battery voltage less than 9V is not recommended and can damage the NiMh battery.

If a battery is dead and the node is needed for gameplay immediately, swap the NiMh battery with a charged one.

NOTE – THE INTERNAL CHARGER IS INTELLIGENT, AND WILL SWITCH TO FLOAT MODE AUTOMATICALLY. THE DEVICE CAN BE LEFT PLUGGED IN INDEFINITELY WITHOUT CAUSING BATTERY DAMAGE.

BATTERY REPLACEMENT

As this unit uses a 9.6V NiMh Airsoft battery with a deans connector. Please replace the battery with a suitable sized replacement.

Unscrew the bracket holding the battery down and one or more of the side screws to free the battery.

This is a standard battery design, and any battery with similar specifications can be used – whether it was sold for airsoft or R/C use. A higher capacity battery will provide more run time during low sunlight periods, but the current draw of the flag is not high and does not require high capacity batteries.

Dispose of or recycle according to local ordinances.

FUSE REPLACEMENT

Fuses should not typically blow unless an internal short develops in the device or a component. Before replacing a fuse, investigate the component that blew the fuse and verify it is not malfunctioning. If the main 3A fuse blows, open the battery cover to switch it out.

Component	Fuse Size	Purpose
Main Battery 3	3A	Main power for all systems.

AUXILLARY INFORMATION/SPECIFICATIONS

FLAG NODE INTERNAL COMPONENT LIST

The following components are used in this device.

Component
Main Battery. 9.6V NiMh battery with deans connector. 3A Main fuse on battery.
Control box. Arduino Nano controller with custom program, power regulation as well as control MOSFET switches and the radio module. Control system fuses and battery charger. Main power switch turns on the control electronics and LED/audio.
"Main Button" – main button used to interact with the device.
Power Switch. Switches power to control box only – however this will generally turn off all components. The charger will operate regardless of system power switch state.
LED display – Red, Blue and Green LED displays.

INTERNAL COMPONENTS:

CONTROL BOX:

MAIN CPU BOARD

MISCELLANEOUS SPECS:

Weight: .3 Kg or 2 lbs.

Width: 0.1M or 4 in.

Height: 0.3M or 10 in.

Power Supply: Internal 9.6V NiMh battery, deans connector.

Power Draw: 3A Max, intermittent. 2mA in sleep mode.

Theoretical Battery Life – 8Ahr/(1A average)=8 hours? Exact time estimates depend heavily on options chosen and amount of game play, as well as amount of available strong sunlight.

Date of Creation: September 31st, 2016.

Paint Codes: RUST-OLEUM Hammered spray paints, Silver 7213

Fuel Rod/Canister modification: The fuel rods or canisters must have a strong magnet to trigger the sensor in the bottom left canister slot (over the left support). A small strong magnet is embedded in the bottom of the canister slot to trigger Fuel Rod sensors as well.

Schematic:

Print copies of the following sheet for in-field reference.

This device is designed to enhance game play in an Airsoft scenario game. It is not dangerous or life threatening, assuming normal Airsoft game play rules are followed. Following typical rules, *especially eye protection*, when the BB Cannon is enabled should protect players from injury. The device is not intended to be moved during game play, especially by less than 2 people. Always instruct players to keep clear of the BB Cannon at all times, regardless of whether the system is powered or armed. When not in use, cover the cannon to prevent debris from entering or protect if accidental discharge occurs.

While it should be readily apparent to anyone this is a prop, based on design, it is still prudent to cover and conceal the device from general public view when not in use on the playing field.