Autonomous surf life saving device

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Abstract—**Make boat that saves people**

I. Introduction

II. System overview

III. Communications

Communications between the SRB and the base station are done using XBee radios. By attaching a pair of XBee modules to the base station computer and the on-board Arduino, a virtual serial connection is effectively created between the two devices.

A. NMEA 0183 protocol

NMEA 0183 is a communications specification designed to create a standardised serial interface for GPS devices. Every NMEA 'sentence' begins with a `$` and ends with `*CS\r\n`, where `CS` is a two-digit hexadecimal checksum of the sentence.

A common NMEA sentence type is `GPRMC`, the GPS recommended minimum. `GPRMC` sentences are specified as follows: [1]

```
$GPRMC,<Time>,<Status>,<Lat>,<LatDir>,
<Lon>,<LonDir>,<Speed>,<Angle>,<Date>,
<MagVar>,<MagDir>*CS
```

Where:

`<Time>`	UTC timestamp in HHmmss format
`<Status>`	Status `A`=active, `V`=void
`<Lat>`	Latitude in ddmm.mmm format
`<LatDir>`	`N` or `S` hemisphere
`<Lon>`	Longitude in dddmm.mmm format
`<LonDir>`	`E` or `W` hemisphere
`<Speed>`	Ground speed in knots
`<Angle>`	Track angle in degrees from north
`<Date>`	Date in DDMMYY format
`<MagVar>`	Magnetic variation magnitude
`<MagDir>`	Magnetic variation direction

A NMEA sentence parser was written for the SRB to interpret messages from the on-board GPS and extract location information.

B. Proprietary NMEA sentences

Some advantages of using NMEA sentences are that they are standardised, human-readable, robust, and relatively simple to implement. Specified below is a set of custom NMEA sentence types was created for communication between the SRB and the base station.

1) SRBSM - Status Message: The `SRBSM` sentence is sent periodically by the SRB to update the base station with status information.

```
$SRBSM,<ID>,<State>,<Lat>,<Lon>,<Speed>,
<Heading>,<BattV>,<FwdPower>,
<TgtHeading>*CS
```

Where:

`<ID>`	ID of target SRB
`<State>`	`0`=disabled, `1`=manual, `2`=auto
`<Lat>`	Latitude in decimal degrees
`<Lon>`	Longitude in decimal degrees
`<Speed>`	Speed in metres per second
`<Heading>`	Compass heading in degrees CW from north
`<BattV>`	Current battery voltage
`<FwdPower>`	Forward power from -100 to 100
`<TgtLat>`	Target latitude in decimal degrees
`<TgtLon>`	Target longitude in decimal degrees
`<TgtHeading>`	Target heading in degrees CW from north

2) SRBJS - Joystick: The `SRBJS` sentence is sent by the base station for manual control of the SRB.

```
$SRBJS,<ID>,<FwdPower>,<TgtHeading>*CS
```

Where:

`<ID>`	ID of target SRB
`<FwdPower>`	Forward power from -100 to 100
`<TgtHeading>`	Target heading in degrees CW from north

3) SRBWP - Waypoint: The `SRBWP` sentence is sent by the base station to autonomously direct the SRB to a set of coordinates.

```
$SRBJS,<ID>,<TgtLat>,<TgtLon>,<TgtHeading>,
<Power>*CS
```

Where:

`<ID>`	ID of target SRB
`<TgtLat>`	Target latitude in decimal degrees
`<TgtLon>`	Target longitude in decimal degrees
`<TgtHeading>`	Target heading in degrees CW from north
`<Power>`	Motor power to use from 0-100

References

[1] D. DePriest, "Nmea data," accessed November 2018. [Online]. Available: https://www.gpsinformation.org/dale/nmea.htm