Autonomous surf life saving device

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***Abstract*—build boat**

I. Introduction

Visiting the beach with family and friends is a favourite pastime of many, but things can quickly turn ugly when the surf becomes rough or a treacherous rip appears. Surf life savers patrol popular beaches to help those in need, but there is still a limit to the speed and ability of a human swimmer.

To supplement the activities of surf life savers at public beaches, a system has been proposed that will allow timely help to be given to people in need while they wait to be rescued. The surf rescue boat (SRB) aims to not only deliver help quickly, but also reduce the risk to which life savers are exposed.

A simple water-based robot such as the one proposed can be constructed relatively cheaply and easily with off-the-shelf components. In the future, systems such as these may become widely available and save the lives of many along our coastal beaches.

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>*CS`

Where:

`<ID>`	ID of target SRB
`<TgtLat>`	Target latitude in decimal degrees
`<TgtLon>`	Target longitude in decimal degrees

IV. Further development

References

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