

## Senior Design Project Description

<b>Company Name</b>	<i>Barnabas Research, LLC</i>	<b>Date Submitted</b>	<i>07/29/2020</i>
<b>Project Title</b>	<i>SCUBA AR Integration Project (BAR SCUBA)</i>	<b>Planned Starting Semester</b>	Fall 2020

### Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

<b>Discipline</b>	<b>Number</b>	<b>Discipline</b>	<b>Number</b>
Mechanical	2	Electrical	2
Computer		Systems	
Other (Computer Science)	2		

### Company and Project Overview:

Barnabas Research is an NC LLC that performs research in the areas of:

UAVs and unmanned systems

Computer interface/operator interface systems in constrained environments

### Project Requirements:

The objective of this project is to create a fully functional prototype of a SCUBA diving mask system that provides the wearer with information during a dive underwater via an augmented reality display. The wearer shall be able to interact with the system via gesture control while underwater in varying conditions of lighting and visibility within identified boundaries.

At the end of the project, the deliverable will be tested in controlled/pool conditions at a depth of fifteen feet for one hour followed by an open water test at a depth of fifty feet. Tests will be conducted in both daylight and nighttime conditions. Tests will incorporate standard SCUBA practices such as mask clearing (removal, replacement and evacuation of water while underwater and cleaning/defogging while being worn).

The project will select one or more commercially available Augmented Reality display units and adapt the unit(s) for use underwater.

### **Expected Deliverables/Results:**

- End deliverable: A functional SCUBA diving mask with the following capabilities:
  - Display the following parameters using VR (Heads Up)
    - Depth
    - Compass heading
    - Cylinder gas Pressure
    - Estimated air remaining
    - Rate of air consumption
    - Time in water
    - Remaining Time at Depth
    - Ascent/Decent Rate
    - Battery Status
  - Provide the wearer with an unobstructed view (with equivalent light transparency) comparable with a standard recreational SCUBA dive mask.
  - The unit must function down to a depth of 100m.
  - Provide for cooling and operation of all subsystems for the duration of a dive of one hour or greater.
  - Incorporate/Provide for and display the following sensors and inputs:
    - Date/time
    - Depth (via an integrated ambient water pressure sensor)
    - Air/gas pressure from cylinder via:
      - Physical connection from mask system to tank
      - Radio transmitter connected to tank valve
    - Compass heading
    - Water Temperature
  - On-board Calculations
    - Provide the functions currently available in a commercially available recreational dive computer initially for both air and Nitrox operations but extendable to mixed gas diving.
  - Utilize gesture control to provide wearer interaction with the device.
  - Project Extensions (future):
    - Position/Path Tracker
      - Investigate/select/integrate tactical grade IMU

### **Disposition of Deliverables at the End of the Project:**

Hardware developed is the property of the Industry Supporter. Typically the work product is displayed at the last Expo then immediately handed over to the supporter unless arrangements have been made to deliver at a future date. Confirmed.



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- Plan is to take deliverable to Tampa, FL in May of 2021 for display and demonstration during the 2021 Special Operations Forces Industry Conference (SOFIC).
- It will be demonstrated for a variety of equipment manufacturers in the recreational and commercial SCUBA industry.
- The platform(s) will be employed for ongoing development of operator interface functionality.

**List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):**

- 3D printing: It is anticipated that the team will design and fabricate a mask housing which can withstand the underwater environment at the depths indicated.
- Electrical interface: The team will design and fabricate interfaces for sensors
- Programming/user interface: The team will design and create algorithms to access data from sensors and create displays in the AR domain.
- Roles and skill sets:
  - Mechanical Engineering:
    - Design and fabricate mask housing
    - Adapt camera optical characteristics for use underwater
    - Design and fabricate waterproof penetrations for connections/sensors
    - Design cooling systems to support operation in water.
  - Electrical Engineering:
    - Integrate Sensors (Depth, Temperature)
  - Computer Science
    - Program operator interface/displays to interact with operator