**Multidisciplinary Senior Design**

**Project Readiness Package**

Prepared by Joe Pannullo/Don Pophal] on 1/8/2021

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| **Project Title** | BUGTORCH |
| **Project Number** | [Assigned by MSD] |
| **Primary Customer** | BugTorch Systems LLC - Joe Pannullo - [joe@bugtorch.com](mailto:joe@bugtorch.com) |
| **Sponsor** | BugTorch Systems LLC |
| **Faculty Champion** | [Assigned by MSD] |
| **Other Support** | [As applicable] |
| **Project Guide** | [Assigned by MSD] |
| **IP Considerations** | Assigned to Sponsor |

**When complete, please submit this document through our online form, located at** [**https://goo.gl/forms/J3G8G2jhTUFuJCYe2**](https://goo.gl/forms/J3G8G2jhTUFuJCYe2)

**Project Information**

**Overview**

Context

Covid-19 has invoked new social constraints, compelling change and priority resets. The global challenge reverberates in recreational and hospitality settings, even in our homes, pushing safest harbor outdoors, presenting new challenges. This setting elevates eco-friendly pest control to a critical must-have. Nothing retards outdoor activity like uncontrolled biting pests, except bad weather.

Mosquitos are greatest menace for spreading disease like dengue, malaria, zika, yellow fever, west Nile, and others, causing millions of deaths annually. 35% of global population lives in areas where risk of such diseases is high. Statistics published in 2019 by US Center for Disease Control and Prevention (CDC) state the incidence of dengue has risen by 30 times in past 30 years and the parasite disease transmitted by repeated mosquito bites called lymphatic filariasis affects 120 million people in 72 different countries. No panacea exists.

There are two ways to manage flying pests: kill them (pesticide) or keep them away (repellent).   
Chemical pesticides are toxic, end up in ground water, are inappropriate in food service settings.   
Effective but impractical to maintain, standalone citronella tiki torches repel mosquitos and flying pests   
in an eco-friendly way. This project proposes to build a scalable tiki-torch system which will monitor and automatically refill each individual tiki-torch as fuel is consumed.

Problem Statement (e.g., define the problem you want to solve)

Citronella Tiki torches are an environmentally safe way to repel unwanted insects in an outdoor environment allowing persons to socialize in a safe outdoor environment while enabling social distancing with outdoor fresh air to minimize Covid-19 spread. The Tiki torch must be continually refilled while burning or the torch will extinguish and not provide protection from flying pests, which may be a public health risk. The goal of this project is to design and develop an automated fuel refilling system for each Tiki torch, networked within an (up to) 20 torch system.

Fuel must be monitored at each torch and when it runs low, a signal must be sent to a device which will refill each individual torch. A system to store and move the fuel through a system of hoses will fuel each individual torch as needed to allow for a continuous burn time for each and every torch in the system, and is to be controlled by a central microprocessor and be controlled by a cell phone app.

BugTorch is a patented system (US Patent No: US 10,842,146 B1) designed for deployment in any topographical setting supported by sensors, electronics, and mobile app. Installation occurs using standard flex tubing and connectors for trenches, configured on-site to fit unique needs of any coverage area. Installation and maintenance may be DIY or performed by third parties.

The MSD team can work within the existing patent space or work beyond it to identify a solution space for the system to properly operate, potentially resulting in additional Intellectual Property (assigned to the sponsor) to be filed.

Prior work, including any previous MSD teams

No prior MSD team work.

Project scope (e.g., what is the goal for this particular MSD team, include both realistic and reach goals, where appropriate)

1. Identify low-cost solution to monitor the fuel in the torch and report the level to a central controller.
2. Build a microprocessor control system to receive signal levels from each individual torch and to then dispatch signals to a central reservoir to refuel each individual torch.
3. Design a network to refuel each torch individually.
4. Control the system from a cell phone app.
5. Build a prototype of a working system.

**Preliminary Customer Requirements (CR)**

*What attributes does the customer seek in the final project? Each CR should map to one or more ER (see below).*

* Device must monitor the fuel level in each individual torch and report a high level and a low level for purposes of refueling.
* System automatically refuels an individual torch when the fuel level reaches the ‘low level’ and stops fueling when it reaches the ‘high level’
* System fuels from a central fuel point which is connected to each individual torch.
* When in operation the system should operate automatically with no human interaction for a period of 8 hours.
* The system should be controlled by an App which provides identified statuses to the user and the ability to turn system on and off.
* System should be scalable to support up to 20 torches (A demonstration system of 8 torches is acceptable).

**Preliminary Engineering Requirements (ER)**

*Include both metrics and specifications. Each ER should map to one or more CRs (see above).*

*Metrics: what quantities will be measured to verify success?*

*Specifications: what is the target value of the metric that the team should design to?*

Engineering Requirements must correlate with Customer Requirements in a traceable fashion.

Identify and validate all fluid system material selection (pump, nylon tubes, size, flow rates, pressure (volume, distance, …

**Constraints**

*List any external factors that limit the selection of alternatives, e.g., allowable footprint, budget, required use of legacy hardware/software.*

1. Sponsor will supply torches to MSD made to attach fuel line to threaded port of entry at tank bottom. Specialized torch heads are supplied by offshore OEM, manufactured under Sponsor patent license grant.
2. Plumbing connectors and fuel lines to system may be purchased or supplied as determined. Mission relies on low cost plumbing components and supply.
3. Cost to build for a 4-torch system to be below $TBD.

**Project Deliverables**

Minimum requirements:

* All design documents (e.g., concepts, analysis, detailed drawings/schematics, BOM, test results)
* Working prototype
* Technical paper
* Poster
* All teams finishing during the spring term are expected to participate in ImagineRIT

*Additional required deliverables, if needed:*

* *(e.g., submission to a particular conference or competition, invention disclosure, on-site installation, video clip of final project/lightning talk video)*
* Lightning talk video – scope tbd
* Installation instructions and video
* Customer research and documentation
* IP considerations by mutual agreement and legal review, to include invention disclosure

**Budget Information**

Total project budget of $4,000 less the value of any customer-supplied components (see below).

Sponsor will provide specialized torches configured to connect fuel port. Plumbing components are standard supply, subject to validation by intern

**Intellectual Property**

Any Intellectual Property developed by the MSD will be assigned to Sponsor. Any patents filed as a result of the development by the MSD team will list all MSD team members as Inventors.

*Product is subject of one USA patent issued, two pending, an international filing (under Patent Cooperation Treaty) covering four distinct disclosures and one foreign filing (National Phase). Fully disclosed means we need not be overly concerned with patent infringement. Any effort presents the idea that we have (at least) a several right to results of any output. If we share source code or proprietary electronics for testing /QA, that needs to be subject to standard protection.*

**U.S. Citizenship**

No concerns or limitations.

**Project Resources**

**Anticipated Student Staffing by Discipline**

*Please provide a brief explanation of the expected activities for each required discipline. “Other” includes students from any department on campus besides those explicitly listed. For example, we have done projects with students from Industrial Design, Business, Software Engineering, Civil Engineering Technology, and Information Technology.*

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| **Department** | **Expected Activities** |
| Biomedical Engineering | None |
| Computer Engineering | Microprocessor Control and source code |
| Electrical Engineering | Electronics associated with all aspects of the design, including fuel level sensing system, pump and distribution systems, etc. |
| Industrial & Systems Engineering | As needed |
| Mechanical Engineering | Reservoir and piping system needs; fuel sensing system |
| Other |  |

**Required Resources**

*Describe the resources necessary for successful project completion. When the resource is secured, the responsible person should initial and date to acknowledge that they have agreed to provide this support. We assume that all teams with ME/ISE students will have access to the ME Machine Shop and all teams with EE students will have access to the EE Senior Design Lab, so it is not necessary to list these. Limit this list to specialized expertise, space, equipment, and materials.*

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| **Faculty** | [List individuals and their area of expertise (people who can provide specialized knowledge unique to your project, e.g., faculty you will need to consult for more than a basic technical question during office hours)] |
| **Environment** | [e.g., a specific lab with specialized equipment/facilities, space for very large or oily/greasy projects, space for projects that generate airborne debris or hazardous gases, specific electrical requirements such as 3-phase power] |
| **Equipment** | [Specific computing, test, measurement, or construction equipment that the team will need to borrow, e.g., CMM, SEM] |
| **Materials** | [List materials that will be consumed during the project, e.g., test samples from customer, specialized raw material for construction, chemicals that must be purchased and stored] |
| **Other** |  |