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Integration of Personnel Tracking in an Augmented Reality Environment

Project Plan

Revised: 09/22/17 | V0.1

Contents

1 Introduction

1.1 Project statement

The goal of the project is to create a Hololens application that shows a live map of where different people are at any given time. The personnel are tracked through a small token, which is attached to issued Personal Perspective Equipment (PPE), that communicates with a distributed tracking system that relays data to the Hololens that a supervisor will utilize for monitoring purposes.

1.2 purpose

Safety is a main concern that is driving this project. When this project is completed and working properly, whoever is using our Hololens application will be able to have accurate location information for their employees. This will prevent any injuries that occur because someone is in the wrong place at the wrong time.

1.3 Goals

Our team would like to have a finished, working Hololens application that can accurately track 6 or more people in a playground-sized (20m x 20m) environment. Our goal is to be accurate from 0.5 m - 1.0 m in length from the location of the user.

We also have some personal growth goals that we would like to achieve throughout the year. We would like to become proficient in understanding location tracking using tokens that are attached to the users. We would all like to understand programming for the Hololens at a high level paired with Unity.

2 Deliverables

1. 491 Deliverables
    a. A proposed solution that include limitations, software and hardware choices, and a work plan (sprint backlog items) to complete by the end of the semester
    b. Hardware with embedded software that act as tokens to send positioning data back to the server
    c. A backend service that allows for collection of data from tokens
    d. Simple web interface to track accuracy of the tracking system
    e. Access to the git repository that contains all the documents from the semester and code written for above systems
2. 492 Deliverables
    a. A work plan for the rest of the project
    b. A modular case for hardware that can fit in multiple areas on a construction worker
    c. An application for the Hololens that gets information from backend service and displays a 3D map with personnel tracking

d. Backend service that renders view from data collection service in real time and sends data to Hololens
e. Backend service that saves personnel locations coming from the data collection service
f. Access to the Git repository that contains all the document from the semester and code written for above system

3 Design

3.1 Previous work/literature

From our team's research, we discovered the following solutions that we will consider in developing our own solution.

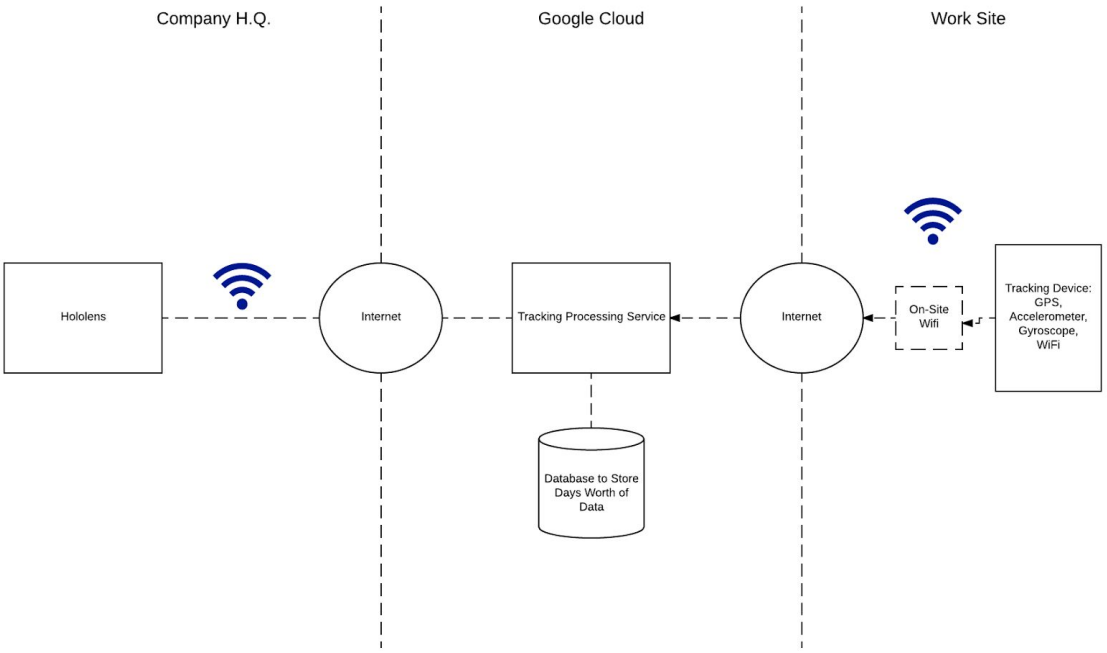
Application of WiFi-based indoor positioning system for labor tracking at construction sites

A multi-range location tracking system for tracking a location objects has one or more GPS-enabled accessory devices

Real-time tracking management system using GPS, GPRS and Google earth

Wireless mobile indoor/outdoor tracking system

3.2 Proposed System Block diagram



3.3 Assessment of Proposed methods

There are many different ways of tracking personnel with different technologies already being implemented. The primary types of technologies we would like to use are:

- Wi-Fi Positioning
- GPS
- Accelerometers
- Barometers
- Cameras

3.4 Validation

We will confirm that our solution works by doing exhaustive testing of the frontend and backend software. We will spend at 2 weeks writing and executing test cases at the end. However, we will be doing iterative testing during development of our software. In addition, we will do hardware testing. We will test against our requirements that we have set with our client and advisor. Our last step in validation will be presenting our final project to our advisor and client for their final "stamp of approval".

4 Project Requirements/Specifications

4.1 FUNCTIONAL

- Must track at least 6 people in playground-sized environment (20 x 20 m): the end goal is to be able to track our group successfully in a small coned-off simulated outside work environment.
- Must be accurate within 0.5 - 1 meter: the tracking must show the avatar as accurately as possible to track people in real time.
- Token relays info to Hololens: Create tokens that relay info to hololens in readable format
- If active sensor, battery life = 1 work day (10 hours): needs to be able to last an entire workday without being charged.
- Sensor communication range: 10 m: must have a minimum range of 10 m to limit the number of sensors needed.
- Real Time tracking: acceptable delay of 1 second: if there is too long of delay the positioning will not be accurate on a moving target.
- Store 1 day's worth of data: this will help to keep a heat map to show where the worker has been for the past day, allowing supervisors to keep workers honest about where they spend their time.
- Track people moving at maximum of 5 mph: this will allow the positioning to still be accurate on someone moving at a reasonable speed.

4.2 NON-FUNCTIONAL

- Realistically-sized token: wearable device (preferably attached to PPE)
- Token must be a water resistant, withstand external forces (durability): main use case is a construction site for our phase, so it must be durable and be able to withstand outside weather conditions.
- System secured so inaccessible to unauthorized users: must be secure so others cannot gain access and view positioning of workers, very negative consequences in future phases.
- Create a system that is scalable to larger projects: must be able to scale for projects that have a lot more than six workers.
- Maintainable for length of project: for construction site, must be able to be easily maintained for length of construction project, so months at a time.

4.3 STANDARDS

IEEE 802 Standard

This standard is relevant to wireless local area networks. This is relevant to our project because we are working with wireless networks. Our practices will not be considered unethical by this IEEE standard.

http://www.ieee802.org/

Microsoft C# Coding Conventions:

There is not a standard created for the C# language according to Microsoft. However, there is a guide that includes naming conventions, layout conventions, commenting conventions, and

Language Guidelines. These guidelines are not technically standards and they are not approved by standard organizations like IEEE or ABET. Since this is a coding standard, we will not be doing any unethical practices by standards. These conventions are important for our project and we will use them when we program in C# for the Microsoft Hololens application we will be building for our client to visualize the employees they are tracking.

https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/inside-a-program/coding-conventions

Python Style Guide:

Python provides a style guide for code layout, comments, naming conventions, and use of whitespace. Again, this is not a standard administered by IEEE or ABET. These conventions are important for our project and we will use them when we program in Python for the Raspberry Pi we are planning to use for our hardware component.

https://www.python.org/dev/peps/pep-0008/

5 Challenges

- Having a battery on our location token that lasts for at least 8 hours
- Adaptable casing for different work environments
- Hardware Restrictions - Only having one or two Hololenses
- Understanding the previous senior design group's work
- Interference of wireless signals
- Hardware may be expensive for small workplaces
- Creating a water resistant casing
- Challenges with ethics of employees being tracked at all times (Privacy)
- Working in C Sharp is new and challenging for the team (New Language)
- Completing the expectations that our professor and client have of us

6 Timeline

6.1 First Semester

1. Research many solutions to solve the problem of tracking personnel in an outdoor environment
2. Work with 492 team to better understand how to design mixed-reality application
3. Review tracking solutions with advisor and client
4. Determine top solutions listing pros and cons of each
5. Order parts for best solution while writing corresponding software
6. Implement and demo tracking solution prototype

6.2 Second Semester

1. Prototype for tracking portion of the project is completed at start of semester
2. Begin work on Hololens application
3. Work on connectivity between tracking tokens, servers, and Hololens
4. Test how all parts work together
5. Discover errors and make changes after collaborating with the client
6. Repeat testing and fix different errors
7. Make finalized product
8. Demonstrate final product

7 Conclusions

Our goal for 491 is to create a system that allows for tracking 6 people in a outdoor playground-sized environment. This will allow for us to move on for phase 2. Phase 2 will consist of creating an application for the Microsoft Hololens using Unity/C#. Ultimately, we plan to have a working solution that will integrate hololens, for visualization, with a tracking system that will provide real-time monitoring for improved safety and efficiency of an outdoor work area.

8 References

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