Augmented Reality Monitoring System

IOWA STATE UNIVERSITY

Optical Operations

Team Information

Client
Optical Operations LLC

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Introduction

Motivation

- Companies are investing in monitoring workplaces and operations to improve safety and efficiency
- Industry wants to reduce insurance premiums by increasing safety and awareness of projects
- Augmented reality is a up and coming technology used to view 3D spaces in real time
- There is interest in the industry for an application that monitors confined work areas and this project aims at providing a solution to that problem

Intended Uses

- Construction Companies
  - Cranes
  - Bulldozer
  - Trucks
- Farm Industry
  - Autonomous Tractors
  - Ag Robots

Figure 1 - Quarry mining site

Intended Users

Supervisors of projects where heavy machinery is used in a confined location

- Supervisors
- Civil Engineers
- Project Managers
- Insurance companies

Objectives

Overall Objective

- Provide a solution to remotely track and monitor worksites with vehicle activities
- Give managers easy access to data relevant to each vehicle
  - Speed
  - RPM
  - Throttle
  - Location
- Provide a remote solution that can be placed inside the cab of most vehicles
- Create an application solution that displays a worksite in real-time

HoloLens

- Receive CAN Bus data from server and display in GUI
- Place realistic map on table
- Display and update position and direction of vehicles in real-time

Figure 2 - Original application demo

Raspberry Pi

- Collect GPS data from GPS receiver
- Collect basic CAN Bus data from the vehicle CAN Bus network
- Transmit collected GPS and CAN Bus data to server

Server

- Receive incoming data from Raspberry PIs
- Forward received data to HoloLens when requested

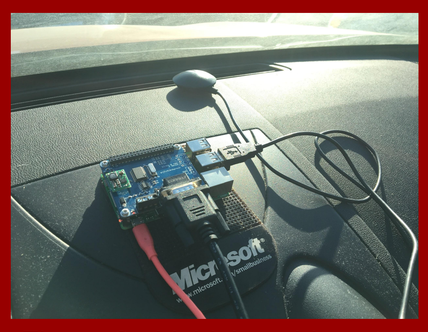
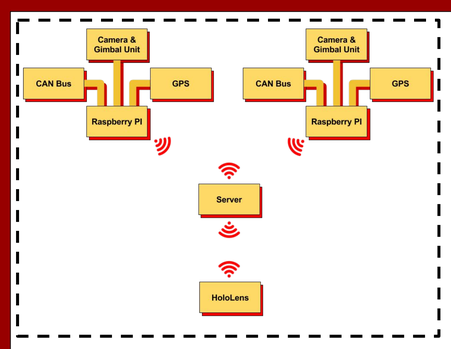


Figure 3 - Vehicle cabin setup

Design



Original Design

- HoloLens
- Server
- Raspberry PI
  - CAN Bus
  - GPS
  - Camera & Gimbal Unit

Final Design

- HoloLens
- Server
- Raspberry PI
  - CAN Bus
  - GPS

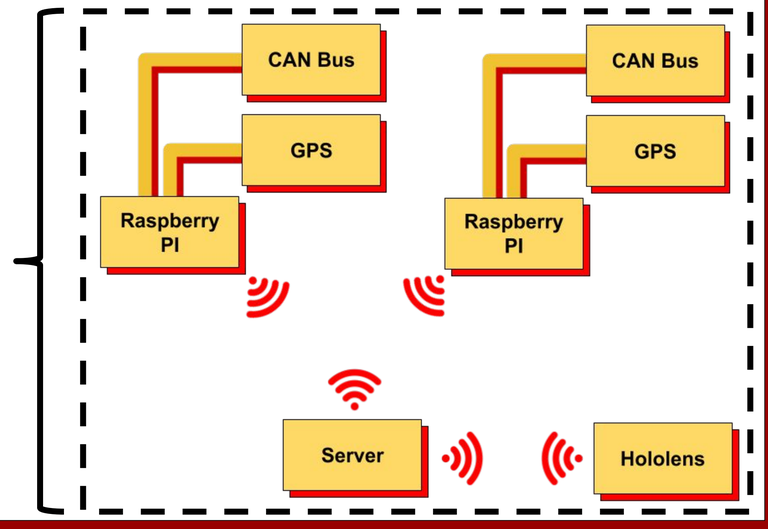


Figure 4 - Comparison of overall system between project outset and project close

Rationale for Design Change

- Original design included a camera/gimbal component included in the solution
- The camera would be used to stream video to the hololens application
- Camera/gimbal feature was left out because client prioritized other features

Future Work

Further Work in This Application:

- Better Hololens Support
- User Login
- User Interface
- Addition of Video Monitoring via Camera and Gimbal

Future Applications In:

- Sporting Events
  - Nascar
  - F1
- Real Time War Visualization
  - UAZ
  - Military Compounds

Glossary and Technologies Used

Technologies

- Raspberry PI
- CAN Bus
- GPS
- Microsoft HoloLens
- C++
- C#
- Python
- Redis
- Swig
- Unity
- Vuforia

Figure 5 - Microsoft Hololens

Terminology

- AR - Augmented Reality
- CAN Bus (Controller Area Network Bus) - this is the bus system over which networked components in a vehicle communicate
- Gimbal - a pivoted support providing rotation about a number of axes
- Raspberry PI - A small single-board computer
- Redis - An open source database API
- Swig - Development tool that rewrites C and C++ into a variety of high-level programming languages