Team 1

Hug the Rails IoT Project

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Section 1: Introduction

1.1 Problem Statement

Current train systems require wifi connection to receive information about weather conditions; however, with the loss of internet and cellular connection it is difficult for operators or train systems to receive data and adjust accordingly. By using sensors that allow us to access data on precipitation and wind speed, we will be able to monitor and adjust the speed at which trains travel without having access to wifi. This will allow passengers to arrive at their destination in a safer manner and will also be more cost effective as monitoring and adjusting speeds locally in hazardous conditions will lead to fewer maintenance issues within the trains themselves.

1.2 Stakeholders and Users

The stakeholders for this project will be the NJ Transit Corporation, who have asked us to add IoT devices and software to their trains to account for inclement weather or other safety hazards. In addition to the NJ Transit Corporation, Reza Peyrovian and Leah Mitelberg are two high priority stakeholders. This will make the job of the user, or the locomotive operator, easier; they will have our software, run by inputs of the sensor data, changing the operation of the train automatically for the train to run in the most efficient and safe way possible, while still being able to enter commands and receive the status.

1.3 Importance and Values

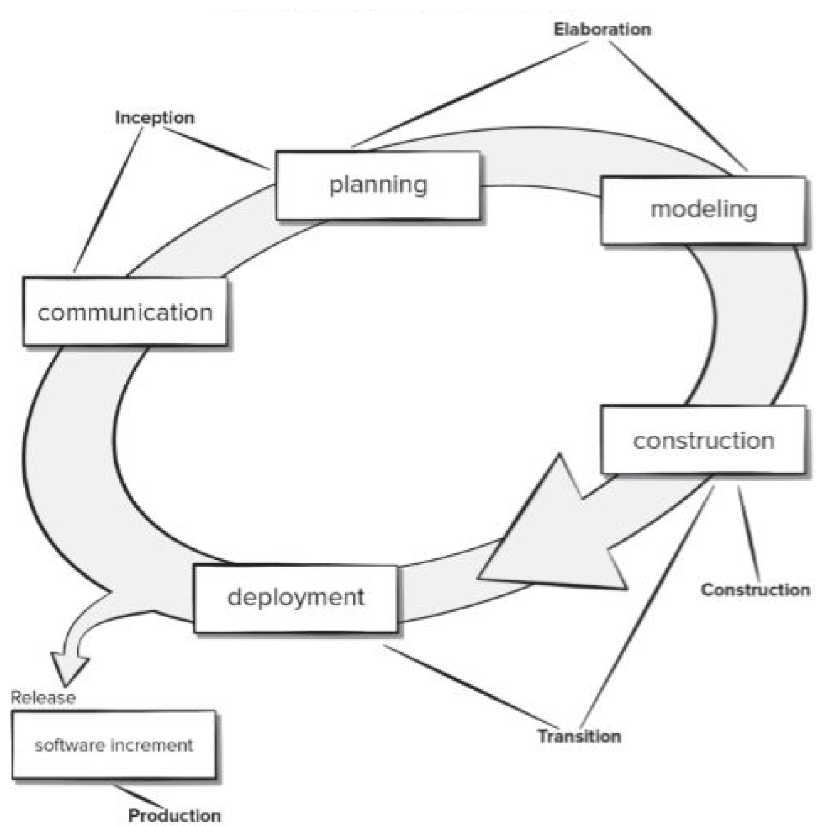
Without any manual intervention, data and tasks will be transmitted and executed. Since IoT reduces human effort, more time will be saved, costs will be reduced and safety will be improved. As a result, increasing opportunities to analyze data in real-time and to further improve operations. For example, IoT significantly improved farmer lives through smart farming. Farmers use IoT enabled tools to monitor soil composition, soil moisture levels, and livestock activity. The tools collect data that can be analyzed to determine the best time to harvest plants.

1.4 Expected Delivery

We began this project on February 9th, and hope to have a complete and functional product which will be ready for deployment by April 1st.

1.5 Approach

Throughout this project, we will be implementing the unified process model. This will allow us to have a large amount of quality documentation for the duration of the project. The quality documentation will ensure that the group has enough information so that the actual construction process will be well defined and easy to follow. Also, as the group gets feedback from Professor Peyrovian and Leah, the requirements will be flexible enough to change or modify based on their requests. The unified process model accommodates requirements changes very well, which is another good reason that the group decided to choose this model.



The chart above outlines the flow of the unified process model. The start date for the group was 2/9, when the group began communicating. The planning phase extends through 3/4, where the group defined the problem and requirements for the solution. The modeling phase will last from then until 3/18, and construction will follow until the deployment date of 4/1.

Section 2: Overview

2.1 Define IoT

Iot or Internet of things refers to a system of interconnected, interrelated objects that collect and transfer data over a wireless network without any human intervention. In other words, Iot is an extension of the internet and other networks using sensors and devices.There are several components that come into play regarding Iot: sensors, connection and identification, actuators, Iot gateway, the cloud, and user interface. Sensors are able to measure observable changes in the environment. The type of data collected is primarily dependent on its function. In regards to connection and identification, data must be communicated from the device to the entire Iot system which is accomplished using its IP address. Iot devices should be able to take action based on data collected from sensors and the feedback received from the network. In addition, the Iot gateway acts as a bridge for different devices' data to reach the cloud. Once the cloud has received the data, software can easily reach this data for processing. This is beneficial in the long run as individual devices do not have to reach the cloud separately (less burden). Lastly, user interface allows users to make necessary changes executed by these devices, which adds quality to the overall user experience since there are several types of communication demonstrated (Device-to Device, Device-to-Cloud, Device-to-Gateway, and Back-End-Data-Sharing).

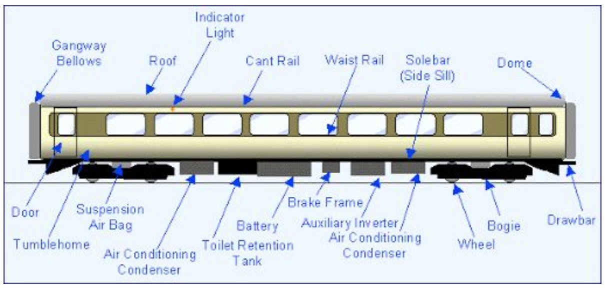
2.2 Define the Problem

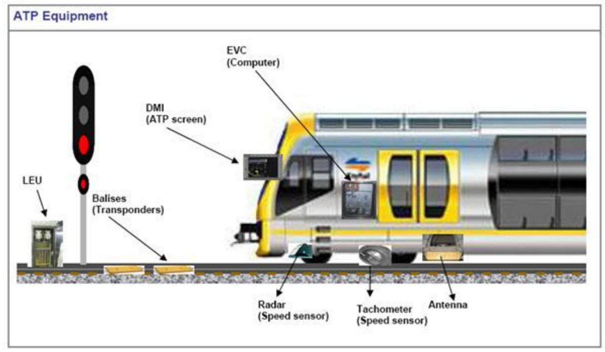
The operation of a train is often dependent on wifi network availability to receive data about environmental, travel, and traffic conditions. Based on those data, the train operator makes decisions about how the train operates. The purpose of this project is to use IoT to make those decisions locally, without being dependent on wifi network availability. This is important because if the train gets disconnected or the network fails, the train is able to continue operating safely.

2.3 Explain how IoT can Solve the Problem

The Internet of Things will help us solve the problem by allowing us to use two different types of sensors. The first type of sensor will allow us to detect how much precipitation is occurring in the area where the trains will be traveling. Based on the information received, the train will slow down (if there is a lot of rain) or maintain normal speed (if there is little to no rain). Similarly, the second type of sensor will allow us to monitor wind speeds in the path of the train. Just like the precipitation sensors, the wind sensors will either maintain the trains current speed (if the wind speed is negligible to low) or slow down the train (in the case where wind speeds could make traveling dangerous). By adjusting the trains speed in hazardous conditions, we hope to achieve a safer method of transportation for customers.

2.4 Overview of Architecture and Components





Components:

- Precipitation Sensor: Detect rainfall in a given area
- Wind Speed Sensor: Detect wind speed in a given area
- IoT Engine: Takes input from sensors and run diagnostics
- Separate Display System: Display output and notifications from IoT Engine

Architecture:

- Information from precipitation and wind speed sensors are run through IoT engine
- Metrics are displayed on a separate display system
- IoT engine alerts the operator if changes need to be made

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