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IOT APPLICATION: ROAD MONITORING & MAINTENANCE

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ABSTRACT

Monitoring road and traffic conditions in a city is a problem widely studied. Several methods have been proposed towards addressing this problem. Several proposed techniques require dedicated hardware such as GPS devices and accelerometers in vehicles or cameras on roadside and near traffic signals. All such methods are ex- pensive in terms of monetary cost and human effort required. We propose a non- intrusive method that uses sensors present on smartphones. In propose system we use accelerometer, GPS sensor readings for road conditions detection. We are specifically interested in identifying braking events - frequent braking indicates congested traffic conditions - and bumps on the roads to characterize the type of road.

In this fast-moving world that we live in, safe commute is not only everyone's priority but also to provide a hassle-free shuttle between places is the government's duty. In this paper, we propose a system which detects potholes on the road. As we all know prevention is better than cure, we design and implement a system which not only recognizes potholes but also stores this data on a cloud platform which can act as a database for further reference and enable us to analyze the data. The proposed system contains two important functions, first is to detect the pothole which is done through a multi-sensor subsystem consisting of accelerometer and gyroscope and secondly warn the driver and store this information on a cloud base which can be accessed by other users which will help them apprehend the potholes on their way. Once the location of the potholes is known, Government authorities can be informed about the same.

Keywords: Smartphones, KNN Algorithms, Vehicle, Android application, IR Sensor.

INTRODUCTION

Motivation

With the increase in world's population, there has been increasing load on the infrastructure. Roads have been flooded with the vehicular traffic. It has become increasingly difficult to manage this traffic. This is the prime motivation behind making a vehicle intelligent enough to aid driver in various aspects. One of the increasing problems the roads are facing is worsened road conditions. Because of many reasons like rains, oil spills, road accidents or inevitable wear and tear make the road difficult to drive upon. Unexpected hurdles on road may cause more accidents. Also because of the bad road conditions, fuel consumption of the vehicle increases; causing wastage of precious fuel. Because of these reasons it is very important to get the information of such bad road conditions, Collect this information and distribute it to other vehicles, which in turn can warn the driver. But there are various challenges involved in this. First of all there are various methods to get the information about the road conditions. Then this information must be collected and distributed to all the vehicles that might need this information. Lastly the information must be conveyed in the manner which can be understood and used by driver. We in this project try to design and build such a system. In this system the access point collects the information about the potholes in the vicinity of a wireless access point and distributes to other vehicles using a wireless broadcast. Here 'vicinity' is a user defined term. Ideally the vicinity is every rout till the next access point.

Problem Definition

Pothole detection system is a system that aims at warning the driver about the uneven roads and potholes in its path. We study the different ways in which goal of the system can be achieved. We justify the methods we have chosen in this projects. And then we give details about the working of the different subsystems. The problem statement can be given as follows.

This system consists of two components one is mobile node and other is the access point.

Access points responsible for storing the information about potholes in its vicinity, taking the feedback from vehicles, updating the information in repository and broadcasting the information to other vehicles. Whereas Mobile node which is the small device placed in vehicle is responsible for sensing those potholes which it did not have previous information about, locating and warning the driver about the potholes which it has information about, and giving the data about newly sensed pothole to access point. The whole scenario works as follows. While deploying the access point we feed in some initial data about potholes to it. Then it keeps on broadcasting the data. Vehicle equipped with the client device catches that data. Now the device has the information about the locations of potholes. The device is responsible for warning the driver about occurrences of pothole. But new potholes may

always be formed because of environment or fatigue. So client device also acts as a sensor and finds out the occurrence of newly formed potholes on the road. If it finds out any new potholes it gives data of new pothole to Access point in terms of the feedback. Access points updates this information to its data store and then adds it to the information broadcast.

SOFTWARE REQUIREMENTS SPECIFICATION

Introduction

Purpose

In our system, road conditions could be detected and identified by readings from accelerometer and gyroscope sensors. The life cycle of our system is divided into 2 phases: training and prediction. The existing system contains two important func- tions, first is to detect the pothole which is done through a multi-sensor subsystem consisting of accelerometer and gyroscope and secondly warn the driver and store. This information on a cloud base which can be accessed by other users which will help them apprehend the potholes on their way. Developing a sensor with the help of ARDUINO including Python Programming.

Project Scope

The system manages the device with the help of various sensors, actuators and micro controller (Arduino). This system is able to identify the uneven potholes. All the information is reported to the user through Android application. Maintenance can also done with sensor data.

User Class and Characteristics

User of this system should be able to view the current recorded potholes location. In any pothole occurs it will indicates to driver by popup notification. In this system user functionality is less as the system itself do work by it own. User should able to perform following functionality:

1. User
   - Registration
   - Login:
   - Add current location
   - View pothole
   - Add pothole

2. Admin

- Add dataset
- Data Monitoring
- Duplication Remove And Management

Functional Requirements

Potholes Detection

This system detection of potholes with its location and stored online to database provides record for analysis. This system alone work with senors and cognizable values stored and provide accurate location about potholes which minimize accident ratio and saves life as well as vehicle maintenance.

Analyzing Recorded data

While data is recorded by different sensors and stored to database. With C4.5 and KNN Algorithm data can analyze and generate a location information. Which will help for data access to android application and road authority for maintained.

External Interface Requirement

Interface

- Front-End Software : Android Application(Android)
- User log-in
- Admin Log-in
- Global Data structure
- Hardware Interfaces
  - Android Mobile
  - Vehicle Device

Non Functional Requirements

Performance Requirements

- System can produce results faster on 4GB of RAM. The system will be avail- able 100 percent of the time.
- Once there is a fatal error, the system will provide understandable feed back to the user.
- Utilization of all sensors is also important thing in this system, as the reading of all parts is necessary to make decisions.

Safety Requirements

- Only users have access to the storage device for using that space.
- All data will be backed-up every day automatically and also the system administrator can back-up the data as a function for him.
- This makes it easier to install and updates new functionality if required.
- For the safety purpose backup of the database must be required.

Security Requirements

- Our System is being developed in Java. Java is an object oriented programming language and shall be easy to maintain.
- The system is designed in modules where errors can be detected and fixed easily.
- For the security purposes and to avoid illegal use of the system, while using this application user must do following things: o at the time of deploying this software user have to register to system. o To use software user have to login and logout each time.

Software Quality Attributes

The system considers following non-functional requirements to provide better functionality and usage of system.

- **Availability:** .User will be use this system by android app on his mobile at any time. Admin also will be add data whenever requirement.
- **Usability:** The system is designed keeping in mind the usability issues con- side ring the end-users who are developers/programmers. It provides detailed help which would lead to better and faster learning. Navigation of system is easy.
- **Consistency** : Uniformity in layout, screens, Menus, colours scheme, format

- **Performance:** The performance of the system should be fast and as per user requirement. From this system we will get expected outcome in less time and less space since efficiency is higher. Speed is totally depending on the response of the database and connection type

- **Security:** The system provides security to the randomly generated private key by performing encryption to it for encrypting patient data and thus protects from other nodes in the network. The network is free from malicious node and misbehaving node attacks.

System Requirements

Software Requirements

- Python 3.0
- Android Studio

Hardware Requirements Arduino Micro controller

- Accelerometer Sensor
- Gyroscope Sensor
- IR Sensor
- Smart Phone Device
- Wi-Fi Module

Analysis Model: Spiral model

Software usability improves the human interface with the software application. The spiral model combines the idea of iterative development with the systematic, controlled aspects of the waterfall model. This Spiral model is a combination of iterative development process model and sequential linear development model i.e. the waterfall model with a very high emphasis on risk analysis. It allows incremental releases of the product or incremental refinement through each iteration around the spiral

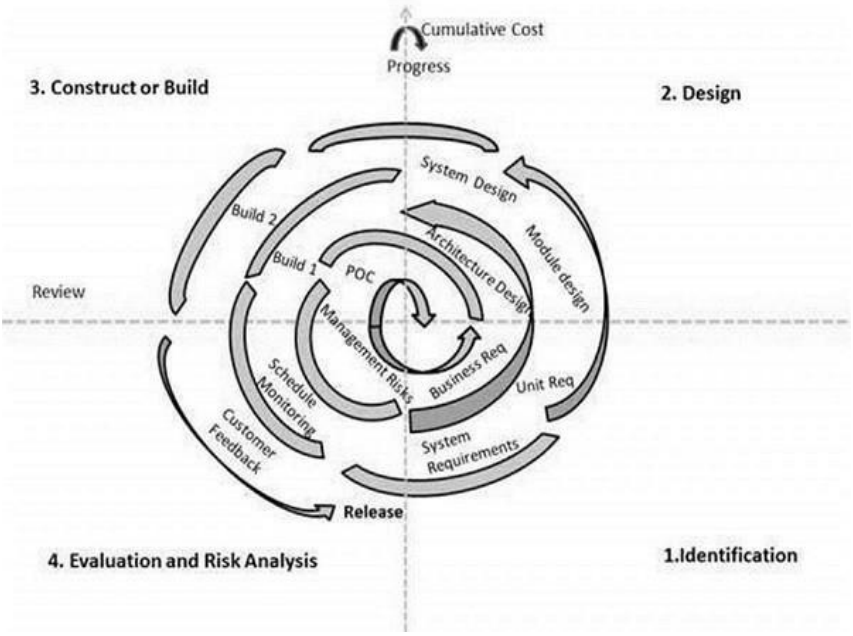


Fig. 3.1 Spiral Model

The spiral model has four phases. A software project repeatedly passes through these phases in iterations called Spirals. it.

Identification

This phase starts with gathering the business requirements in the baseline spiral. In the subsequent spirals as the product matures, identification of system requirements, subsystem requirements and unit requirements are all done in this phase.

This phase also includes understanding the system requirements by continuous communication between the customer and the system analyst. At the end of the spiral, the product is deployed in the identified market.

Design

The Design phase starts with the conceptual design in the baseline spiral and involves architectural design, logical design of modules, physical product design and the final design in the subsequent spirals.

Construct or Build

The Construct phase refers to production of the actual software product at every spiral. In the baseline spiral, when the product is just thought of and the design is being developed a POC (Proof of Concept) is developed in this phase to get customer feedback.

Then in the subsequent spirals with higher clarity on requirements and design details a working model of the software called build is produced with a version number. These builds

are sent to the customer for feedback.

Evaluation and Risk Analysis

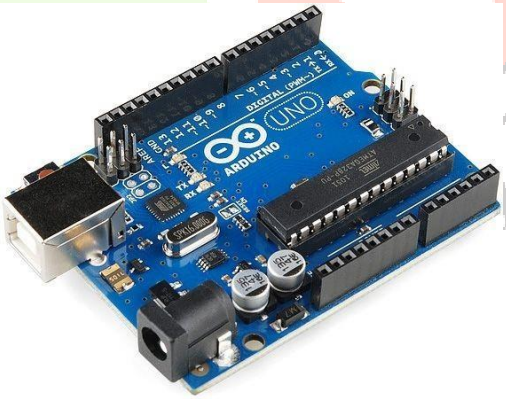
Risk Analysis includes identifying, estimating and monitoring the technical feasibility and management risks, such as schedule slippage and cost overrun. After testing the build, at the end of first iteration, the customer evaluates the software and provides feedback.

The following illustration is a representation of the Spiral Model, listing the activities in each phase.

REQUIREMENT ANALYSIS

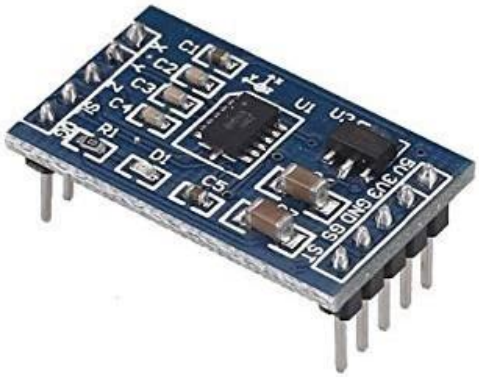
Hardware Requirement

- **Arduino Uno R3:** he Arduino UNO is an Open-Source Microcontroller board based on the Microchip ATmega328P Microcontroller and Developed by Ar- duino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other Microcontrollers. The Arduino UNO is generally considered the most user-friendly and popular board of the



Arduino Board Series.

- **Accelerometers Sensor:** An accelerometer is an electromechanical device used to measure acceleration forces. Such forces may be static, like the continuous force of gravity or, as is the case with many mobile devices, dynamic to sense movement or vibrations. Acceleration is the measurement of the change in velocity, or speed divided by



time. Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers areused to detect and monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright. Accelerometers are used in drones for flight stabilization. Coordinated accelerometers can be used to measure differences in proper acceleration, particularly gravity, over their separationin space; i.e., gradient of the gravitational field.

Accelerometers Sensor

- **GyroScope Sensor:** Gyro sensors, also known as angular rate sensors orangu- lar velocity sensors, are devices that sense angular velocity. Angular velocity. In simple terms, angular velocity is the change in rotational angle per unit of time. Angular velocity is generally expressed in deg/s (degrees per second).

GyroScope Sensor

- **Infrared Radiation Sensor:** An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor.

Infrared Radiation Sensor

Chapter 5 SYSTEM

DESIGN

5.1 System Architecture

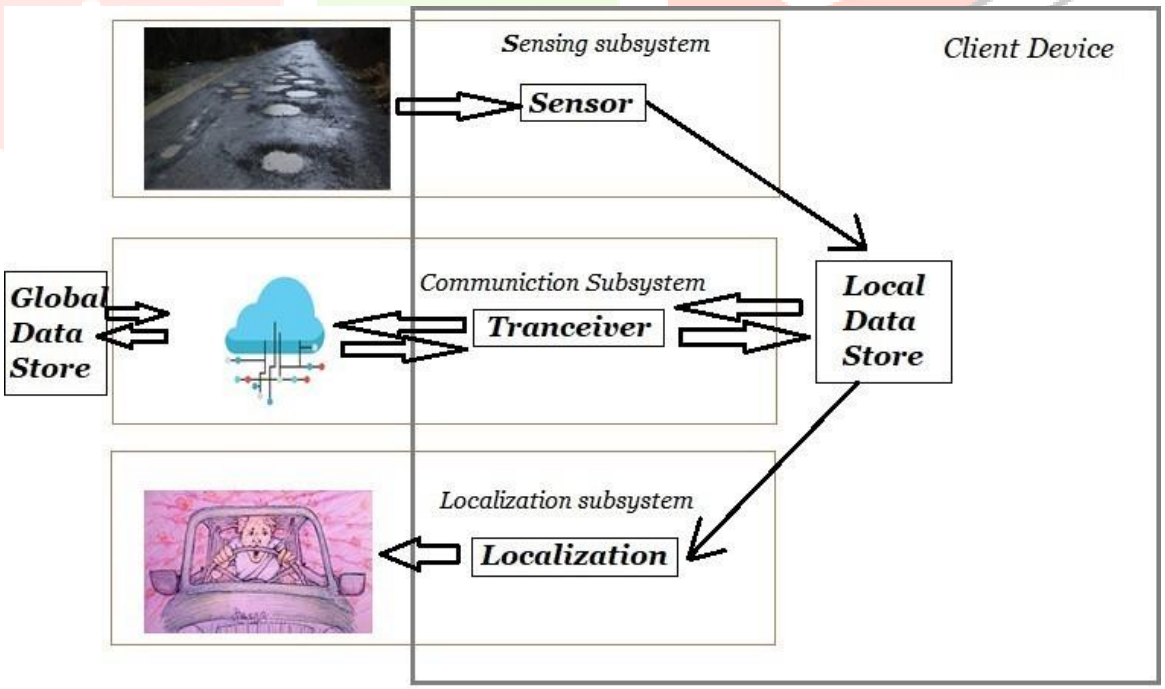


Figure: ***Architecture Design***

CONCLUSION

We have presented the concept of Pothole Detection System using IoT for Monitoring Road and Traffic Condition using various sensors. To overcome traditional methods monitoring like by Camera and visiting to road by a road authority. It will take huge time as well as the cost for monitoring. By applying Pothole Detection System road maintenance become easy and cost-efficient in a short time. And by using recorded data we can easily analyze the road quality of every road and deal with the corruption in road construction. Maintenance of road with minimum cost as well as time and also corruption, which help our country to become a developed Nation worldwide. So, basically, it will play an important role in society towards the development of INDIA.

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