Synopsis

“IoT Enabled Integrated Intelligence System for Automatic Pothole Detection, Pollution Monitoring, Post Accident Medical Response and Breakdown Assistance”

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**Problem Statement**

The objectives of our project is to develop a cost-effective single integrated application to solve the following social related problems using the Internet of Things (IoT). The system is cost-effective as the solutions below solve social problems, all in one system and does not rely on separate individual modules. The objectives mentioned below find the highest social impact with respect to the safety and well-being of public.

We define the problem statement as:

* Potholes have become a menace, causing many accidents, sometimes leading to death. The problem stems from the sheer number of potholes and the lack of identification mechanisms for the civil development authorities to fix them.
* Monitoring the emissions by a vehicle is difficult.
* In case of accidents (especially in remote/isolated roads), getting medical help becomes difficult.
* In the case of major accidents like those involving death, it is seen that it takes time for the guilty to be charged because of insufficient evidence.
* In case of a breakdown (especially in remote places) it becomes difficult for the user to find the nearest service centre and get help.

**Proposed Solution**

1. **Methodology:**

The functional components of our system requires a SoC (**System-on-Chip**), in our case a Raspberry Pi 2 Model B which enables this project to be an Internet of Things Solution. To accomplish the various objectives, we also use the following sensors:

1. Accelerometer

2. Temperature Sensor

3. Impact Sensor

4. Carbon monoxide sensor

All the data and the processing is done on the cloud, a horizontally scalable system. Data that is relevant to organizations like the local civil authorities, the pollution control board, can request the data from our servers through our APIs. All data from and to the SoC are done through POST requests, and security is ensured through IP filtering at the server.

**Pothole Detection and Alerting in Real-Time:**

We detect the potholes using the data from the accelerometer connected to the Raspberry Pi. We get the values in the form of measurements of acceleration in the X,Y,Z axes. The challenge however is to identify speed breakers and ignore such data, and only report information about potholes to the local civil works organization like the BBMP with its exact location, and also store this data on our servers. We filter the potholes by using our algorithm which detects a sudden change in acceleration, called an impulse. The accelerometer will report a value of 9.8ms-2 constantly. However, this changes instantaneously when the vehicle runs over a pothole or a speed breaker. With finer analysis of values from the X and Y axes, we can detect only the potholes. We also report the information about these potholes to the user in real-time through a sound prompt. The alerting is done by the SoC as it continuously reports the user’s location to our servers, which then warn it of upcoming potholes.

**Pollution Monitoring Mechanism at Vehicle Level:**

The SoC monitors exhaust gas emissions through a series of gas sensors placed on the automobile. Gasses like Carbon Monoxide (CO), Oxides of Nitrogen (NOx) etc. are emitted by automobiles and are harmful to humans. The values from the sensors are relayed to our servers periodically. If there is an unusual amount of harmful emissions detected and the level of pollution generated is beyond the regulated amount stated by law, the user is alerted to perform maintenance. Upon continuous reports of the same harmful levels of emission the automobile details such as vehicle number are reported to the pollution control authorities via email generated by the server. This functionality helps the user and local authorities to curb pollution created by automobiles.

**Automated Dispatch of Ambulances in Major Impact Collisions:**

In this integrated approach, we use an impact sensor (used in Airbag deployment) to detect collisions that could have caused grievous injuries. Once the impact sensor is triggered, we record the location coordinates from the GPS module on-board. The location coordinates of this collision is sent to the nearest hospital through its registered mobile number and email address, which can dispatch its ambulance. In the SMS/Email it will contain the current location and time it takes from the location of the hospital to the accident location in present traffic conditions. We use APIs to convert the coordinates to an address and also find the distance and time to reach the spot. We also provide a web interface to the ambulance service of the city (108 Ambulance Service of Bangalore), so that they can dispatch ambulances from the control centre.

**Automated Collection of Accident Related Information for Evidence:**

With this system, the moment there is an impact recorded from the impact sensor, it reports the location coordinates, the cyber timestamp and other details of the vehicle like the registration number to the Police authority, which substantially proves and also automates the fact that an accident occurred at a location, and the exact vehicle that was involved in the accident.

**Automated Breakdown Assistance:**

The moment there is a breakdown, the SoC sends a SOS message to the nearest service centre. The service centre then gets this notification in real-time with the information of what may have caused the breakdown, its location coordinates through a web interface at the service centre and they are able to immediately dispatch a team for help. Through the web interface, they can select with a click of the button, the staff that will provide assistance. This alerts the allotted staff through an SMS and an email, the location of the breakdown and the customer’s phone number. It also sends an email and an SMS to the customer with the nearest service centre, the team dispatched to help, their phone number, the time it could take to reach them in present traffic conditions. We use APIs to get the distance and travel time information. All of this happens within possibly minutes and without the user having to do anything at all. Since the time it takes to respond to a breakdown is drastically reduced, we are also avoiding possible bottlenecks from occurring. A vehicle stranded for an increased amount of time blocks a lane, which causes the traffic pile up. If the time it takes to repair or tow this vehicle is reduced significantly, the traffic pile up is also significantly reduced.