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Implementation of Conceptual Smart Bicycle through Internet of Things

Jason Gilbert Cornelio[1], Kautilay Siingh[2] and Dr. T.H. Sreenivas[3]

[1, 2, 3] Information Science & Engineering, The National Institute of Engineering, Mysore, India

Abstract—In the modern era of transportation, due to the advent of global warming, the exigency of pollution free travel is becoming more omnipresent day by day. This fosters the need for an Eco-friendly vehicle that has features akin to those in contemporary vehicles. The dearth of such features in the aforementioned Eco-friendly vehicles needs to be addressed. The proposed system involves application of features such as navigational, vehicular tracking as well as adaptive lights in terms of luminosity of surrounding light to the quintessential example of Eco-friendly vehicles i.e., bicycles.
Keywords—transport; internet of things; sensors; Bluetooth; microcontroller; openstreetmaps.

I. INTRODUCTION

On the current trajectory of global warming, greenhouse gas emissions from transportation vehicles may become one of the greatest drivers of human-induced climate change. Transportation vehicles such as cars can't harness zero-emissions energy sources without sophisticated and expensive energy storage technologies.

One way to circumvent the limitations of current technology is by integrating features present in vehicles emitting emission to zero emission vehicles (ZEV) like bicycles. The changeover of features from luxury vehicles to bicycles involves developing a system that has minimalistic design in order to be fitted onto the bicycle. Nowadays, cellular devices which run on the android platform are widespread among the society. Therefore, the android platform can be used as a base for the amalgamation of features.

Microcontrollers which are interfaced with an android application are used for implementation. The proposed system has three major features that need to be incorporated. The navigation feature is a compact form of smartphone navigation, thereby, ensuring a less strenuous experience for the user. As the number of bicycles increase, rising sales of cycles will be commensurate to bicycle related crimes. A vehicular tracking feature helps in tracing down the location of the lost cycle in case of theft. Given the fact that a lot of bicycle related accidents occur at night time, there is a requirement for adaptive headlights as well as tail lamps which depend on surrounding light intensity. Adaptive lighting can be implemented using a light dependent resistor sensor which is connected to the microcontroller.

Using the congregation of features present in the android application, the user would be able to navigate easily around the city, locate the cycle in case of theft as well as use adaptive lights which will not only save power but also save lives.

1.1 Objective

The objective of the project is to design a system that provides hapless navigation, vehicular tracking as well as adaptive lighting that can be integrated onto a bicycle.

1.2 Traditional System

In the existing system, each feature is available stand-alone. The problems with the current system are that:

- Mounting a smartphone on a bicycle can divert the users' attention easily. Additionally, the smartphone can be stolen in areas of high crime rate.
- There is a lack of location trackers designed to be fitted onto bicycles.

- The user may forget to switch on the bicycle lights in areas of darkness and it can lead to road accidents.

1.3 Proposed System

The Proposed system tries to address the issue of traditional systems by using following techniques:

- Navigation: User gets alerts based on turn by turn navigation.
- Anti-theft: User can utilize the vehicular tracker in order to locate the bicycle.
- Adaptive lighting: Depending on intensity of surrounding light, headlights and tail lamps are activated.

II. WORKING

The development of this project is divided into 3 main aspects:

- The navigation component of the android application can be constructed using open source map tools i.e., OpenStreetMaps.
- The automatic lighting component which can be developed using light dependent resistor (LDR).
- The vehicular tracking mechanism in situations of theft can be implemented using SIM908 which sends back its location according to the users' needs.

The system consists of the following components:

- Arduino Uno R3 microcontroller.
- Light Dependent Resistor (LDR) sensor.
- GPS-GSM module (SIM908).
- LCD screen (16x2).
- Android 4.0+ device.
- Light emitting diodes (LEDs).
- Bluetooth module (HC-05).

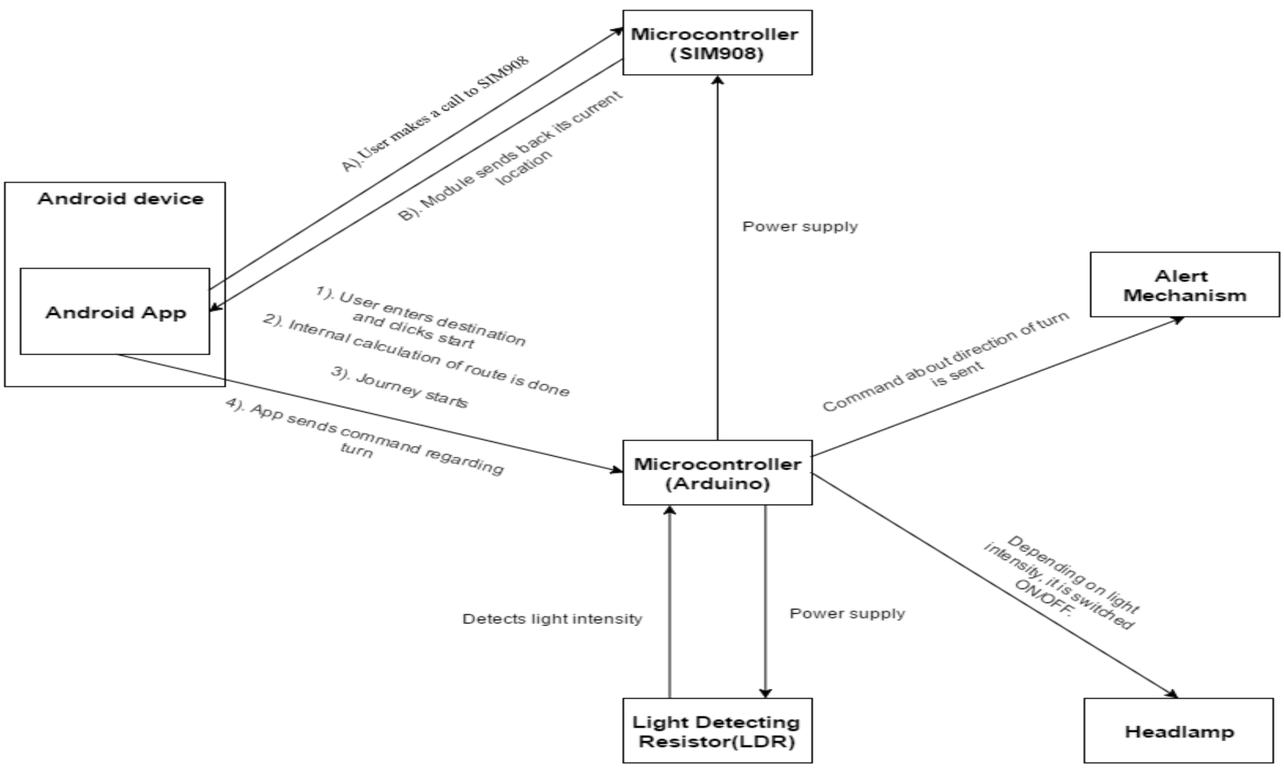

Figure 1. Process flow for smart bicycle.

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2.1. The Vehicular Tracking Component

We make use of SIM908 (microcontroller) to ensure this feature, 12v with 1A current is applied.

- If the user realizes that his/her bicycle is stolen and needs to track it, then the user can enable this feature. Whenever the user clicks the find bicycle button, the android application makes a call to the GSM/GPS module.
- The GPS/GSM module then authenticates the call and if it matches proceeds further as a location provider.
- The module sends back the longitude as well as the latitude as a text message to the android phone. The text message is then interpreted by the android application and mapped onto a map via intent to Google Maps.
- The user then has access to the location on a map and can now trace the path to the lost bicycle.

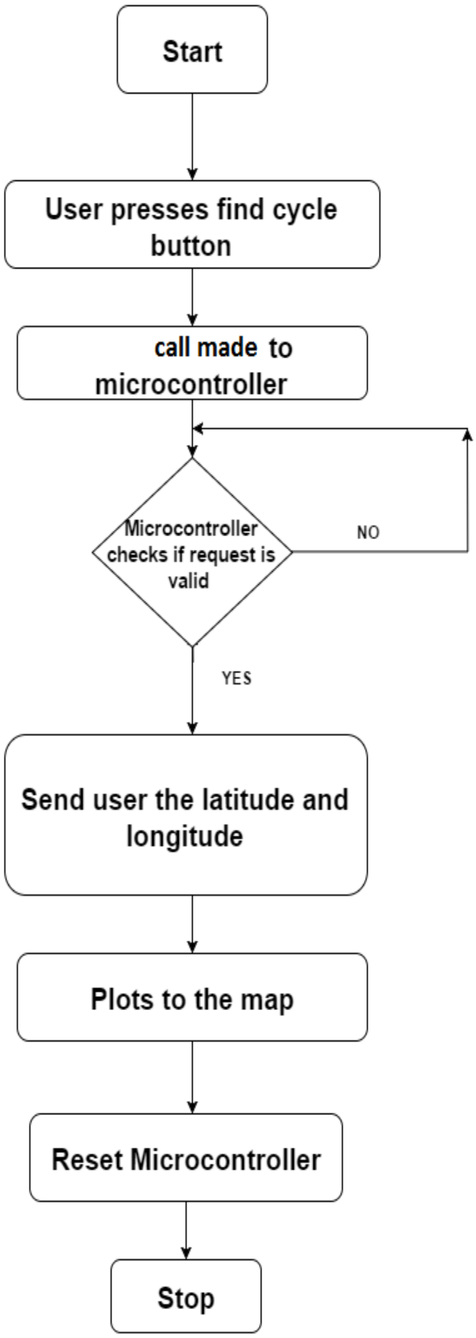

Figure 2. Flow diagram for vehicular tracking.

The Navigation Component

The android application can be constructed using developer map tools i.e., Skobbler SDK coupled with OpenStreetMaps.

In this feature, we make use of a 16x2 character LCD screen coupled with an Arduino UNO microcontroller which is used to display turn by turn instructions in real time via Bluetooth. An HC-05 Bluetooth module acts as an intermediate between the android application and the LCD screen.

These are the sequence of events that occurs when an Android application running on a mobile device is interacted by the user:

- When this mode is enabled, the application first requires the user to input the destination of the users' choice through an edit text box. The internal calculation of the mapping software takes place which gives us all possible routes to the destination.
- From the above data, we can extract the information such as distance to next maneuver, the direction of the turn and type of intersection.
- When the distance and direction metrics are known, the application checks if the distance is lesser than a certain threshold. In this project, the threshold can be taken as 15 meters.
- Whenever the distance is less than 15 meters, the application further checks about the type of maneuver and depending on the maneuver, an alert is sent to the microcontroller about which turn is meant to be taken in case of a roundabout and which direction is to be taken if it's a normal crossing.
- Once the microcontroller gets the alert, it checks which direction and number of the turn that is to be taken. This information is provided as an input from the android application and gives a user understandable output which varies for each type of turn.
- When the destination is reached, the navigation stops and message is sent to the microcontroller. This message is displayed on the LCD screen.

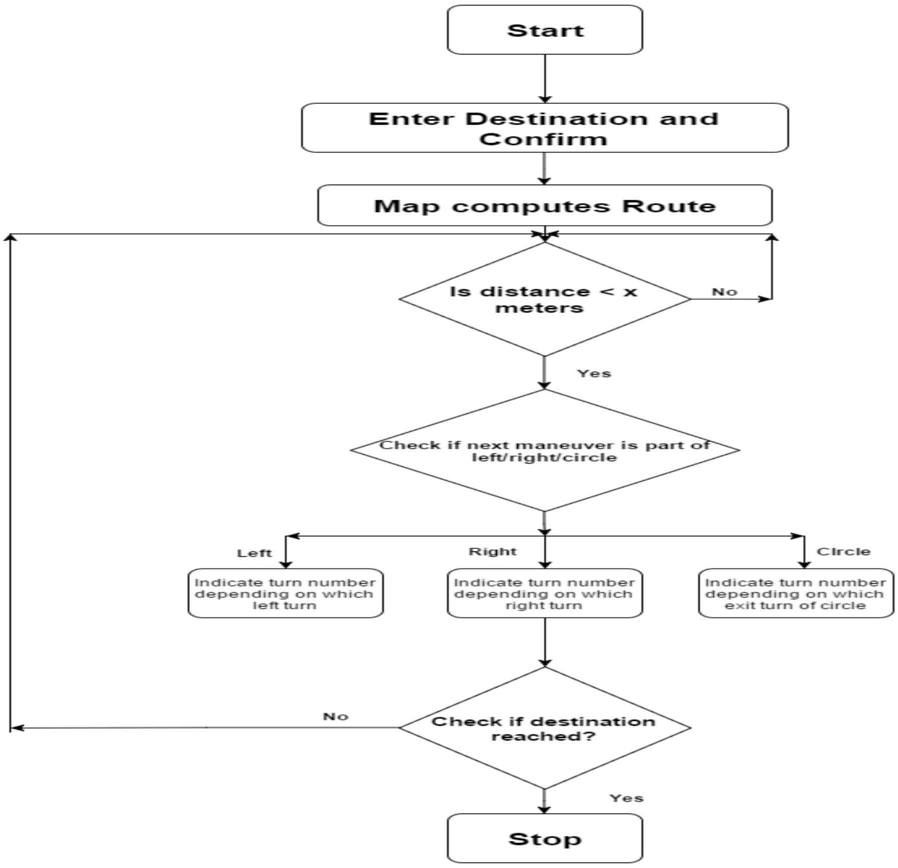

Figure 3. Flow diagram for navigation.

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2.3 The Adaptive Light component

We use two Light dependent resistors (LDR) and 3 LED bulbs while providing 5v input voltage. We connect the LDR to A0 pin of the Arduino which gives the values of light intensity ranging from less than 100 (with light) to 1023 (during darkness) and resistors of 12k ohm, the voltage ranges from 1.36v to 4.0v. In our program, the minimum threshold for the LED bulb to glow is kept at 600.

The following steps are involved in the operation of the adaptive lighting component:

- Depending upon the light intensity falling on the resistor which is connected to the arduino, the LEDs fit on the front and rear of the bicycle are lit up according to a certain threshold.
- A switch connection is established between the arduino and the LEDs in order to ensure that there is no wastage of energy.
- As light intensity increases, the resistance of the LDR decreases according to the formula R=500/Lux.

III. RESULT

The prototype of the following system has been made using the forenamed components and the snapshots of the android application as well as the LCD screen and the collected data is as follows.

Navigation:

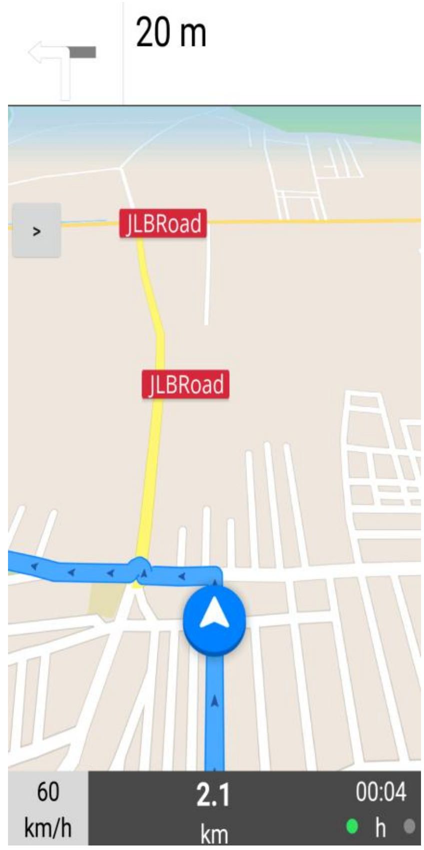


Figure 4. Upcoming left maneuver in app.

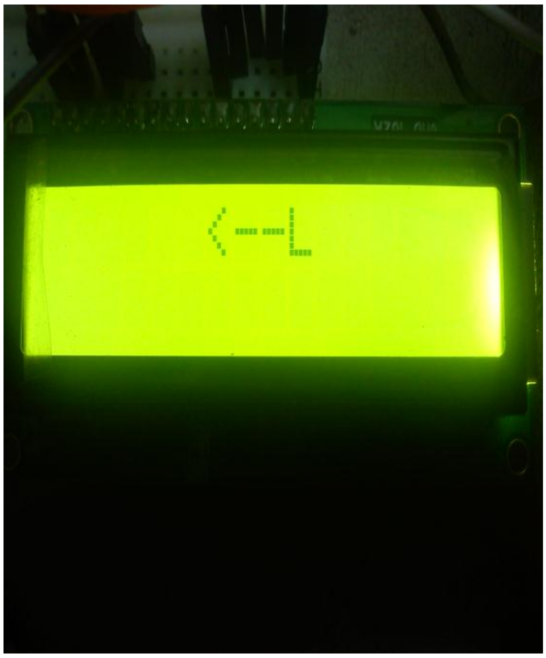
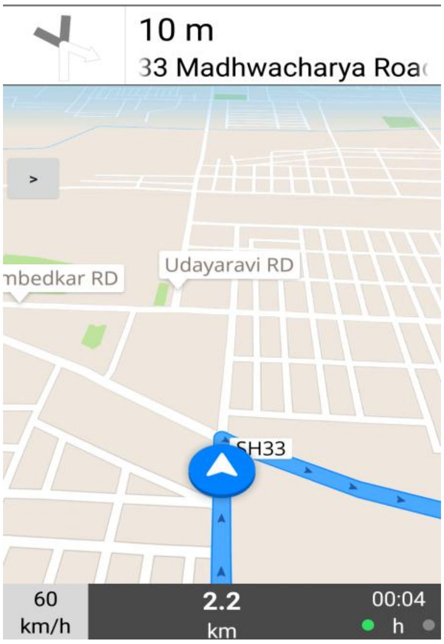


Figure 5. Output shown on LCD to user.



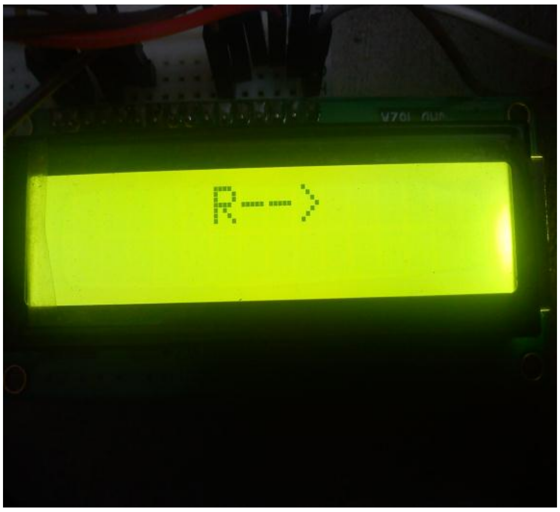


Figure 6. Upcoming right maneuver in app.

Figure 7. Output shown on LCD to user.

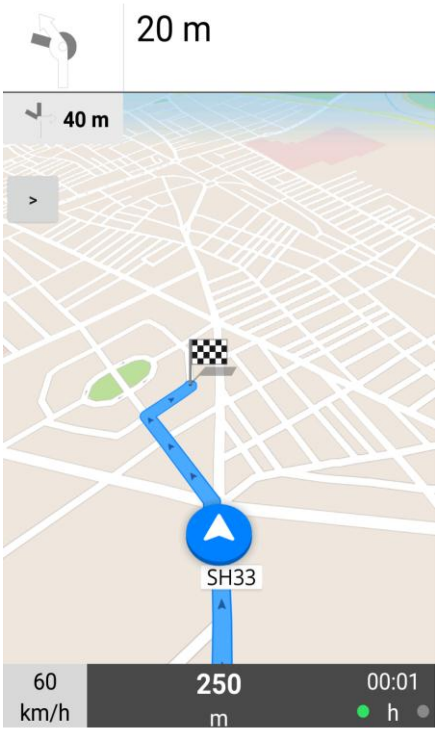


Figure 8. Upcoming round about turn in app.

Figure 9. Output shown on LCD to user.

Vehicular tracking:

The SIM908 sends the user the coordinates in the order of latitude followed by longitude respectively.

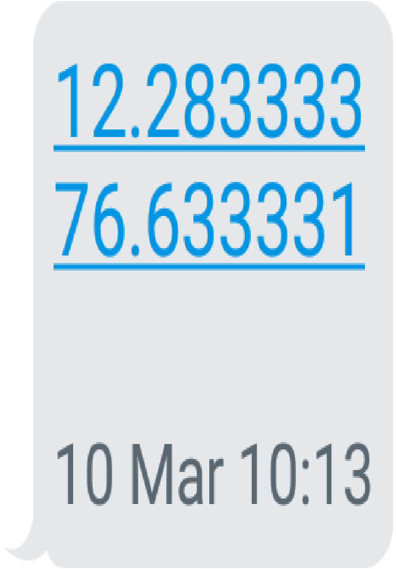


*Figure 10. Message** from the SIM908*

** Message as of 10th March 2016

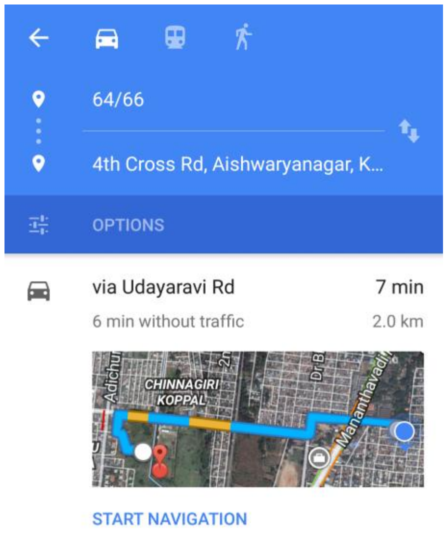


Figure 11. Mapping of coordinates onto Google Maps via intent.

Adaptive Lighting:

Results of the values obtained** from the LDR which were used to set the average threshold for the LED's to light up.

Table 1. Results Obtained from the LDR sensor.

Time of the Day and Values Obtained in LDR at Start of time		Time of the Day and Values Obtained from the LDR at end of the time	
Time	**Values**	**Time**	**Values**
6:35pm	365	6:35pm	392
6:37pm	426	6:37pm	464
6:39pm	507	6:39pm	547
6:41pm	595	6:41pm	636
6:43pm	671	6:43pm	736
6:45pm	787	6:45pm	819

** Values recorded as on 15th February 2016.

IV. CONCLUSION

The main objective of the project is to develop a smart bicycle using the Internet of Things which is capable of simplified navigation, vehicular tracking and adaptive lighting. One of the major quandaries of the present generation is the lack of concern towards global warming. The proposed system will guide people to use bicycles more often due to the additional features, thus reducing the adverse effects of greenhouse gases. Cars contribute a great amount towards global warming, therefore, the increase of zero emission vehicles (ZEV) can provide more time for sophisticated and economical energy storage technologies to be researched upon.

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