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An Iot Approach to The Issues of Bus Commuters

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ABSTRACT

As we are rapidly moving towards the India, which Dr. A.P.J Abdul Kalam mentioned in his vision for India 2020, we have projected our nation as a developing country in transition to developed nation status. The development of smart cites is in full swing and several hundred crores of INR is being spent on the development of smart cities. Various sectors in economy have seen immense involvement of technology. Public transit, especially buses are considered as the lifeline of the nation. But, the development of this sector is very subtle since the last few decades. The introduction of Internet of Things(IoT) in the blooming silicon market provided us with an opportunity to enhance customer experience of bus commuters(especially daily commuters).With the integration of various sensors and Arduino modules, we have designed a solution for various problems(such as overcrowding) faced by the bus commuters on a daily basis. It will help immensely in the development of smart cities which will eventually lead to the nation's overall development.

Keywords: IoT, Smart Cities, Arduino, Overcrowding

I. INTRODUCTION

Public transport has always been the first priority for daily commute on every commoner's mind. The reason why public transports are preferred is that, public transits are relatively cheaper than private travel. Private vehicles require servicing, insurance and repairs on a timely basis. Public transport on the other hand, offers concessions for elderly citizens and also students. Also, public transports are a boon to the environment. Big cities have public transport networks that reach out all around the city, thereby making it very convenient for people. Public transport comes as a boon to all those people who can't drive and are dependent on their friends or relatives to do the driving. Public transportation can convey many more people in much less space than individual auto mobiles, which helps to keep traffic congestion lower, and helps riders avoid the stress that comes from daily driving in highly congested areas.

However, public transports have their own set of flaws. A major drawback to this service, is overcrowding. Due to the burgeoning population of India, there is also an increase in the demand of public transportation. The ratio of buses to the population using the bus services is highly disproportionate. Also, in India, the buses are driven according to the whims of the bus drivers. The money making conduct practised by the drivers often results in overcrowding of the buses. Another downside we see, is that the schedule of the buses is rarely maintained. People end up waiting in their respective stops for long durations, only to find out that the bus arrives completely full. Those people then have to either wait for the next bus, or make other arrangements after wasting time at the stop. The purpose of this document is to provide with

some IoT based approaches that can help solve these problems faced by daily commuters.

This paper attempts to provide solutions to the problems stated above, we want to provide solutions with the help of this paper. For instance, a weight check can be installed on all the buses which will ensure that the buses do not run overloaded. Also, real time data can be provided to the passengers on their mobile devices, regarding the arrival and status of the buses. The status can be shown indicating whether the bus is filled or not. If a person finds his bus already filled, he need not wait until the bus arrives. He can make alternate arrangements. Also, real time information regarding any bus break downs on any route can be indicated on the mobile application.

The paper is organised as mentioned further. Section II talks about **Methods Used** in which, we have briefly explained the methods we have used as solutions to the aforementioned problems. Section III discusses **Implementation Details**, an in-depth view of how the proposed methods are implemented. Section IV and Section V contain and the **Future enhancements** of this presentation.

II. METHODS USED

A. Overcrowding check

A weight sensor is to be installed on the bus, so that the weight can be monitored at all times. This will ensure that the buses are not getting overcrowded. The weight will be checked using a weighing scale built using load cells, Arduino module and a Load cell amplifier -HX711.The scale will be positioned on the buses.

B. Real time data using mobile application

For real time bus tracking, we will be using "The Transport Tracker Solution". This can help us create an Android app which will capture the real time data and store it on an online NoSQL database "Firebase". The map built with the Google Map JavaScript API will provide the real time tracking of the vehicle.

III. IMPLEMENTATION DETAIL

A. Implementing weighing scale sensor

The weighing scale is built using load cells, Arduino module and HX711(load cell amplifier).A load cell is a transducer that can translate pressure (force) into an electrical signal. There are various kinds of load cells available, but we are going to use strain gauge load cells.

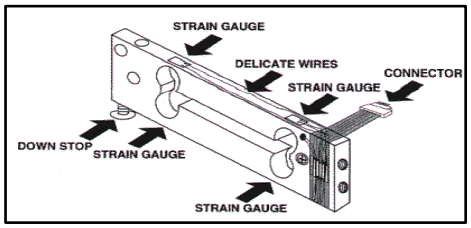

Figure 1. A Load cell

We are also going to use a strain gauge. The gauge factor for metallic strain gauges is typically around 2. Strain measurements rarely involve quantities larger than a few millistrain. For instance-suppose we apply a strain of 500με. A strain gauge with a gauge factor of 2 will have a change in electrical resistance of only 0.1.

$$2 * (500 * 10^{-6}) = 0.1$$

For a 120Ω gauge, this is a change of 0.12Ω.

0.12Ω is a very small number that cannot be detected at all. So we are going to need another device that takes that very small change in resistance and turn it into something that we can measure accurately.

That device that can help us achieve the above, is HX711.

A good way of converting small changes in resistance and into something more measurable is using a Wheatstone bridge.

In a Wheatstone bridge,R1/R2=R3/R4 implies V_{out}=0.

$V_{out}=[(R3/(R3+R4)-R2/(R1+R2))]*V_{in}$ (1)

One of the resistors is replaced by a strain gauge. The change in V_{out} is calculated and the force applied is

studied.

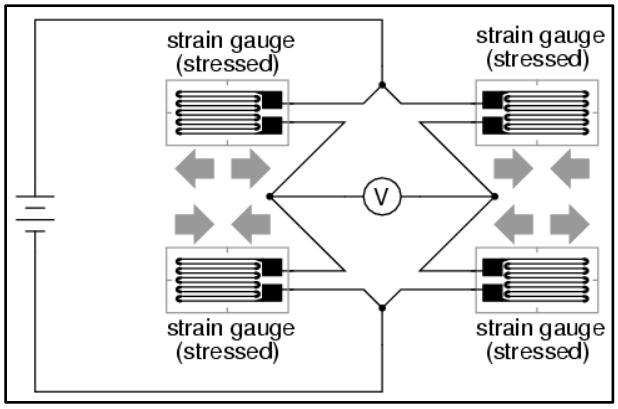

Figure 2. Full-bridge strain gauge circuit

Now, the load cell is connected using 5 wires to the HX711 load cell amplifier. The pins are- RED,BLK,WHT,GRN AND YLW.

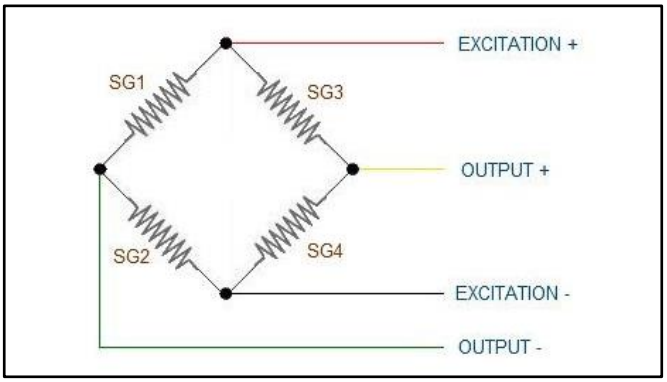

Figure 3. Load cell wiring

Once the load cell is connected to the amplifier, the loose ends of wires(VDD, VCC, DAT, CLK, GND) are connected to an Arduino/RedBoard board.

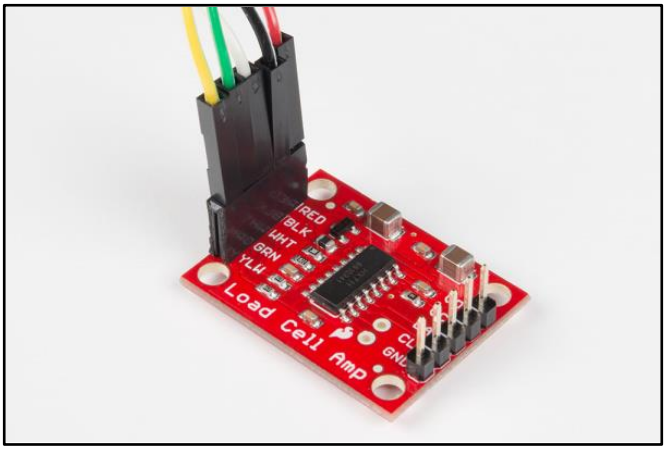

Figure 4. Load cells wires connected to HX711 Amplifier board

After the load cell, amplifier and microcontroller (Arduino/RedBoard) are set up; we can calibrate it to check the weight of the bus, using Arduino codes. The check will ensure that the buses are not overcrowded and accurate information will be processed and passed on to higher authorities, if the buses ply overloaded.

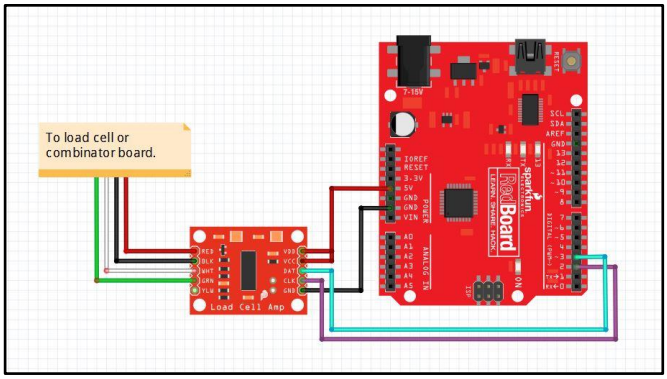

Figure 5. HX711 connected to Red Board

B. Implementation Details of the mobile Application

Different Components:

1. Map

An app based interface that displays information about the current buses plying on the route and the location of vehicle based on the concept of Digital Twin.

Figure 6. Real time information on **map**

2. Bus Location

You can enter the vehicle number into the mobile application and check the details about the same e.g. current occupant check and driver details etc.

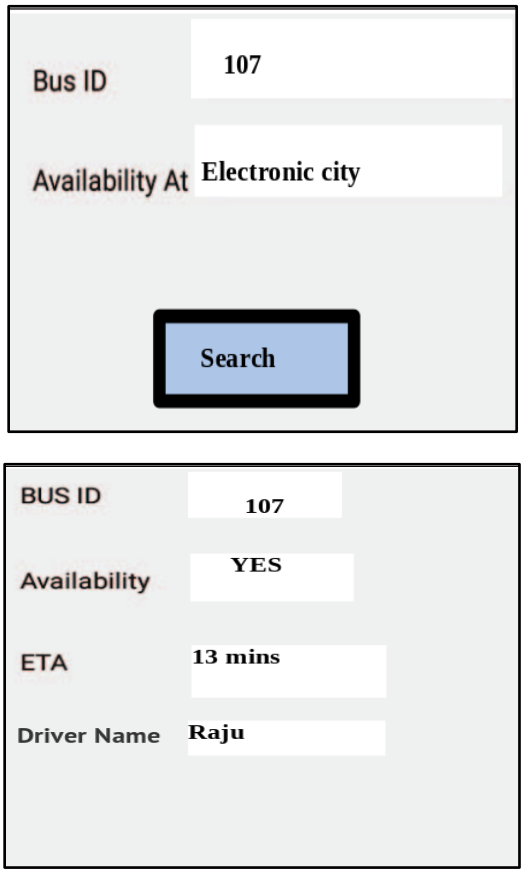

Figure 7. The interface

3. **Admin's Interface**

The administrator will have the control of the application and will monitor the application for trends and with the help of Cookies we can suggest the customers frequently searched bus numbers for the ease of use.

4. The database backend

A Real time NoSQL database Firebase is used to store the vehicle location and occupant status data sent from the vehicle locator and provide real time data synchronization to the map and administrator's overview.

IV. CONCLUSION

The use of public transport needs to be encouraged as much as possible, in today's world, where global warming is such a serious issue. Public transport is a very convenient means of commute for people. But, if people have to think twice before they wait at a stop every time, just to avoid an overcrowded bus, then public transport will not serve its purpose. This paper has presented some solutions that can be used, to help daily commuters. Weighing scales that are built using load cells can help in ensuring that buses do not travel overcrowded. Also, a mobile application that informs passengers real time data related to buses in a route can help people save time, and plan their schedules and arrangements without getting disappointed waiting for a bus that does not turn up, or a bus that arrives filled up.

V. FUTURE ENHANCEMENTS

This architecture can be used for various kinds of public transits, to overcome the problem of overcrowding. The frequency of the number of people requesting information on the application can be used to bring the number of operational buses to a proportionate figure. Another enhancement is that, alternate routes can be provided to users if a certain bus suffers a break down.

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