



KING SAUD UNIVERSITY
COLLEGE OF COMPUTER & INFORMATION SCIENCES
كلية علوم الحاسب الآلي و تقنية المعلومات



Project

School Bus Monitoring and Management System¹

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Dr. Issam Al-Azzoni

The School Bus Monitoring and Management System (SBM2S) is to be deployed on each purchasing school. The SBM2S consists of a central server connecting several smart phones carried out by bus drivers and students' parents. An administrative user (admin) from the school can add bus drivers, parents, and buses. A bus driver can check-in and check-out students and can view routes to the students' home locations using his/her smart phone. A parent can use his/her smart phone to see the current location of the bus carrying his/her child. These are just very high-level features of the SBM2S.

The admin uses a web access interface (a web page) to register bus drivers, parents, and buses. When registering a parent of a student, the admin inputs the location of the parent's son or daughter by clicking on a map. The SBM2S will send an SMS to the newly registered parent or bus driver which includes a unique username/password. A parent uses the username/password to access the system via his/her smart phone. This is the same for the bus driver. Parents or bus drivers can change their password at anytime, but the password should meet minimum standard security-related requirements.

The admin also registers buses and bus drivers. The admin needs to set the capacity for each bus. A bus capacity is the number of students that the bus can accommodate. The admin assigns bus drivers to buses manually. However, the SBM2S automatically assigns students to buses. The system computes a route for each bus. Routes are computed such that the total distance that the buses travel is minimized while respecting the capacities of buses. For that, efficient algorithms such as those for Capacitated Vehicle Routing Problem (CVRP) should be used. Every time a change happens to the number of buses, parents, or bus drivers, the system generates a new route for each bus.

¹ The general ideas are based on the graduation project titled 'School Bus Monitoring System' which was supervised by Dr. Khaoula Hamdi during the 1434-1435 H academic year.

In addition, the admin should have full management capabilities of the bus driver and parent accounts. The admin should be able to access the system using a browser at any time.

A bus driver accesses the system via a smart phone. Before hand, the bus driver should upload the SBM2S mobile app (Android is initially chosen to be the operating system supported by SBM2S). A bus driver should access the mobile app using his/her correct username and password. The bus driver can view the route computed for his/her bus. In addition, the bus driver should be able to view the location of the bus in real time.

A bus driver delivers his/her assigned students from their homes to school in the morning and vice-versa in the afternoon. When the bus driver picks up a student, the bus driver uses the mobile app to check in the student. Analogously, when the bus driver delivers a student to his/her home or the school, the bus driver uses the mobile app to check out the student. The bus driver delivers students in order as outlined by the computed routed for his/her bus. The bus driver should be able to view the number of remaining students who still have not been checked out.

A parent uploads the SBM2S mobile app for parents and accesses the app using his/her correct username and password. A parent should be able to view the location of the bus carrying his/her child in real time. In addition, the parent can view the number of the remaining students before his/her child.

Unusual scenarios can happen and the SBM2S should respond properly to these scenarios. One such scenario is when a student cannot make it to school. In such cases, the parent can use his/her mobile app to inform the system of the student's absence. Here, the SBM2S re-computes a temporary route for the assigned bus driver and notifies the bus driver with the new change and an SMS message is sent to the admin. The same process should be activated if a similar scenario occurs for the return trip.

Every school day, the SBM2S creates records for two trips. The first trip is created 1.5 hours before the start of the first class and lasts for two hours. The second trip is created 0.5 hours before the end of the last class and lasts for two hours as well. A parent may request cancelling the pickup of his/her child anytime before the actual pickup. The bus driver should confirm his availability at the beginning of the trip. During a trip, a bus may break down (or other issues may arise) preventing the bus from transporting students. In such cases, the bus driver should use the mobile app to notify the parents and the admin of the breakdown. The procedures to be followed next are outside the scope of the SBM2S.

The mobile apps should be easy to use by parents and bus drivers. Also, the location of the bus should be accurate and updated continuously.