Group Submission 1: System Engineering

EEE4113F
Engineering Systems Design

University of Cape Town

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Declaration:

1. We are the authors of this work, using our own words (except where attributed to others)
2. We know that plagiarism is to use another's work and pretend that it is one's own, and that this is wrong.
3. We have used *IEEE* convention for citation and referencing. We have provided citations and references in all cases where we have quoted from the work of others, or used other's ideas or reasoning in this essay/project/report.

The writer of each of the sections of this report is listed below:

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Inessa Rajah (RJHINE001)	2.1 Subsystems
Noel Loxton (LXTNOE001)	2.2 Use-Case Example
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Taariq Daniels (DNLTAA002)	2.3 Functional Flow Diagram

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Section 1

1.1 User Requirements

UR1	**On-bike screen**
Requirement	The user requires a touch-screen display on the bike console.
Rationale	It is important for this system to be interactive and remain simple to use. By incorporating a display with touch-capabilities, the user-interface can be both dynamic and functional.
Refined by	UR1:FR1 (On-bike LCD display)
Verification	Verified by simple UI touch- and view- test.

UR2	**Alert System**
Requirement	The user requires an emergency mechanism system at their disposal during an adverse situation.
Rationale	Riding a bike is undoubtedly a dangerous task, for a multitude of reasons. There are of course road-accident dangers—either coming off the bike for some reason, or being hit by another vehicle at high-speed. Furthermore, there are safety concerns: the risk of being mugged or hijacked. In the case of an emergency, the user will likely be panicked, and it is crucial for them to be able to signal an alert easily and quickly.
Refined by	UR2:FR1 (Tangible Panic Button) UR6:FR1 (Dash Camera)
Verification	Verified by doing a panic button test.

UR3	**Automatic Check-in System**
Requirement	The user requires a convenient way of updating their employer that they are safe, alert, and indeed fulfilling the jobs they have set out to do.
Rationale	There is a chance that the bike driver will fail to trigger the alert system in a difficult situation. In this case, an automatic alert should be triggered based on the driver's failure to 'check-in'. Having said that, this could become inconvenient and even distracting, and must thus be automatic. Moreover, it will be useful for the driver to be able to check-in with the driver to check that they are completing the required jobs, and are remaining alert.
Refined by	UR3:FR1 (Biometric Sensors) UR5:FR1 (Wi-Fi) UR6:FR1 (Dash Camera)
Verification	Verified by automatic check-in test.

UR4	**GPS tracking**
Requirement	The user should be able to track their GPS location and receive navigation instructions accordingly.
Rationale	Many of these bike drivers are already using a device on their trips: their phones. Adding yet another system with a display will be hard to manage, and may even be distracting. Instead, the user should be able to interact with a single device—that which is attached to the bike. This is also safer for the driver, as they can keep their phones hidden.
Refined by	UR1:FR1 (On-bike LCD display) UR4:FR1 (In-built GPS) UR5:FR1 (Wi-Fi)
Verification	Verified by simple GPS test.

UR5	**Wireless Network Communications**
Requirement	The user's device must be able to communicate wirelessly both with their employer and their fellow drivers' devices.
Rationale	An important aspect to this system involves community alerts, and awareness of nearby incidents. It is thus vital that this system can effectively and reliably communicate with other devices wirelessly.
Refined by	UR5:FR1 (Wi-Fi)
Verification	Verified by short wireless connection test.

UR6	**Dash Camera**
Requirement	The user requires an integrated dash camera setup.
Rationale	In an adverse or emergency situation, it is often crucial for video footage to be taken—this could serve to assist in legal processes, or something similar. Moreover, the camera can be used for live updates and check-ins, over the wireless network.
Refined by	UR5:FR1 (Wi-Fi) UR6:FR1 (Dash Camera)
Verification	Verified by inspection.

1.2 Functional Requirements

UR1:FR1	**On-bike LCD display**
Requirement	A low powered LCD touch display shall be mounted on the bike to provide an interactive environment.
Refines	UR1 (On-bike screen) states that the system needs to be interactive yet simple to use which is accomplished by mounting a touch display on the bike. It should be noted that the display should be low powered based on its frequent use. UR4 (GPS tracking) expresses the need to use GPS tracking on an integrated platform for ease and safety of the drivers. The use of an integrated LCD display allows the drivers to have an interactive system on board.
Refined by	Level 3: System Elements (Figure 1)
Verification	Requirement is verified by demonstration of the User Interface and monitoring the device's power rating.

UR2:FR1	**Tangible Panic Button**
Requirement	A tactile, fast response panic button connected to the server shall be triggered to alert in case of emergencies.
Refines	UR2 (Alert System) expresses the urge to use a tangible panic button for ease of triggering an alert instead of navigating the LCD screen during adverse conditions. This device however needs to have a fast response time with minimal lag to ensure quick alerts are possible.
Refined by	Level 3: System Elements (Figure 1)
Verification	Verified by an inspection of the response time of the emergency panic button

UR3:FR1	**Biometric Sensors**
Requirement	Biometric Sensors shall be installed on bike handles to automatically update the employer of a driver's check-in.
Refines	UR3 (Automatic Check-in Sensors) states the implementation of a driver check-in system to ensure their safety. An automatic biometric system solves this by ensuring the driver is present and safe on the bike without them physically checking in.
Refined by	Level 3: System Elements (Figure 1)
Verification	Verified by positive fingerprint recognitions.

UR4:FR1	**In-built GPS**
Requirement	Google Maps for GPS location tracking shall be installed in the on-bike display to ensure ease of navigation for the driver.
Refines	UR4 (GPS tracking) direct flowdown.
Refined by	Level 3: System Elements (Figure 1)
Verification	Verified by simple GPS test.

UR5:FR1	**Wi-Fi**
Requirement	Communications between drivers and employers shall use Wi-Fi as the basic protocol for data exchange.
Refines	UR3 (Automatic Check-in Sensors) expresses updating the employer on the drivers' check-in's which must be made through a Wi-Fi network. UR4 (GPS tracking) expresses tracking and navigation of locations which must be done over a Wi-Fi connection. UR5 (Wireless Network Communications) expresses the urge to use wireless communication facilities. UR6 (Dash Camera) expresses the use of camera for live updates and check-ins over a Wi-Fi network.
Refined by	Level 3: System Elements (Figure 1)
Verification	Verified by short wireless connection test and by inspection of data sent and received from check-in sensors, GPS tracking and dash camera.

UR6:FR1	**Dash Camera**
Requirement	A light, low-powered still camera shall be used for live updates and check-ins.
Refines	UR2 (Alert System) requires an emergency mechanism at the user's disposal. This is achieved by providing video footages using the dash camera which could assist during legal processes. UR3 (Automatic Check-in System) expresses an automatic update of the employee which is achieved by live feeds and online check-ins using the dash camera. UR6 (Dash Camera) direct flow down.
Refined by	Level 3: System Elements (Figure 1)
Verification	Verified by demonstration and monitoring of power rating.

Section 2

2.1 Subsystems

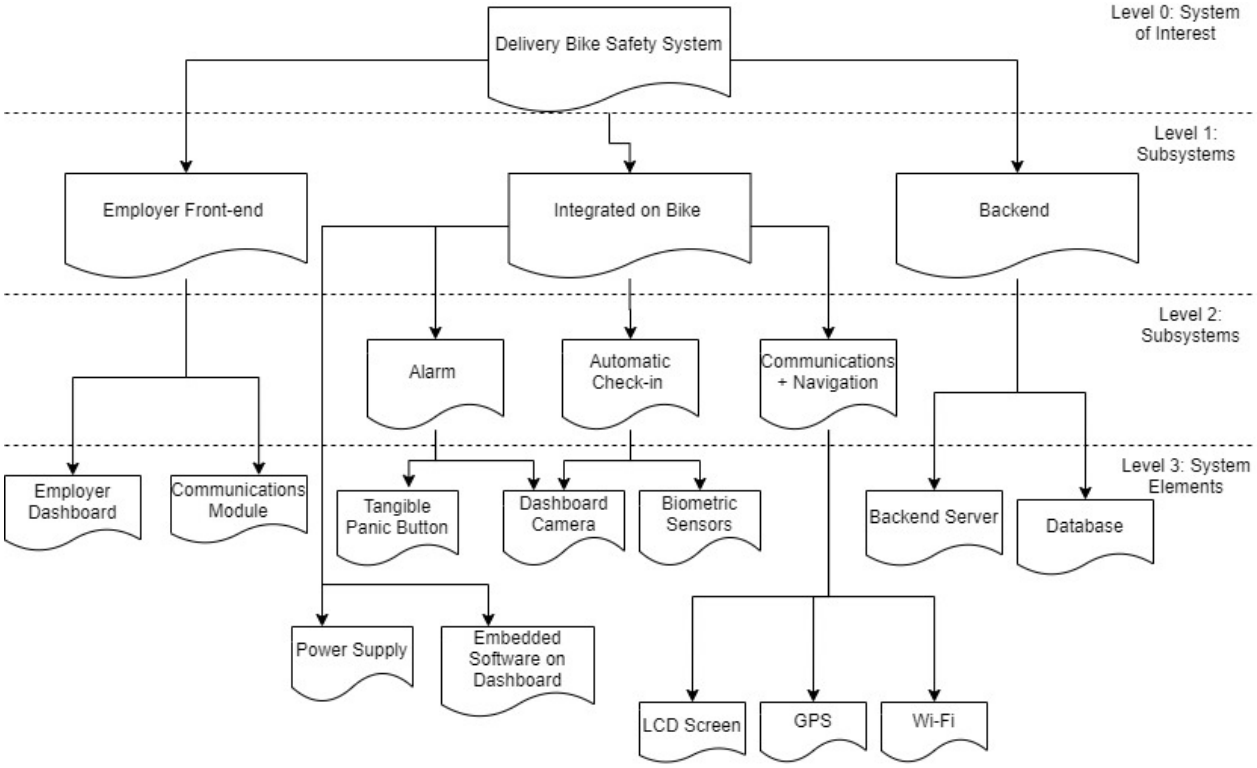

Figure 1: The complete Delivery Bike Safety System divided into its subsystems and corresponding system elements

2.2 Use-Case Example

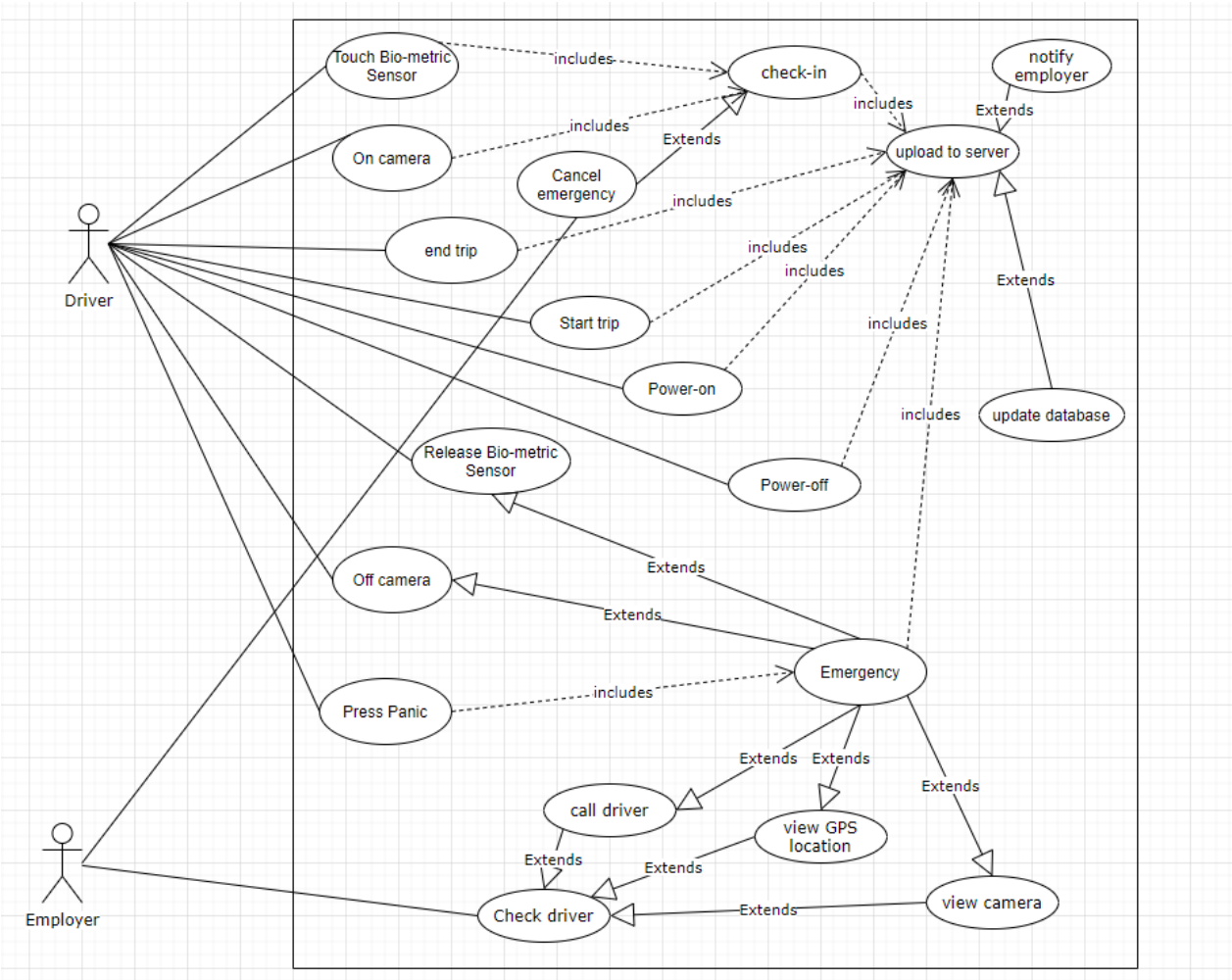

Figure 2: The Use-Case Diagram showing how users and systems interact with one another

Example:
1. Driver powers on bike system
-all subsystems on bike power on
-data uploaded to server indicating the bike is online
-database updated with time bike went online
Note: similar operation for power off
2. Driver touches bio-metric sensor [UR2, UR3], [UR3:FR1]
-"check-in" function activated
-server sent data indicating that driver is currently "okay" i.e. not in a state of emergency
-while touch is active, server updated frequently indicating no emergency
-emergency cancelled
3. Driver releases bio-metric sensor [UR2, UR3], [UR3:FR1]
-timer begins
-waits for bio-metric sensor to be activated
-if not activated – emergency state activated, refer to (7) below...
-if activated – refer to (2) above...
4. Panic button pressed [UR2], [UR2:FR1]
-activate state of emergency, refer to (7) below...
5. Driver on-camera [UR3, UR6], [UR6:FR1]
-if employer attempts to view driver, feed will be streamed to employer
6. Driver off camera [UR3, UR6], [UR6:FR1]
-timer begins
-waits for driver to be back on camera
-if not on camera – emergency state activated, refer to (7) below...
-if activated – refer to (5) above...
7. Emergency state activated [UR2, UR3, UR4], [UR4:FR1]
-upload to server
-update database with GPS location, time and bike ID
-notify employer
8. Driver starts trip [UR1, UR3, UR4, UR5], [UR1:FR1, UR4:FR1, UR5:FR1, UR6:FR1]
-uploads data to server
9. Driver ends trip [UR1, UR3, UR4, UR5], [UR1:FR1, UR4:FR1, UR5:FR1, UR6:FR1]
-uploads data to server
-updates database with trip info
10. Employer checks driver [UR3, UR4, UR6], [UR4:FR1, UR6:FR1]
-one of three options
(i) view the trip location via GPS
(ii) call the driver
(iii) view the dashboard camera feed
-the employer can then activate a state of emergency for the driver (7 above) or cancel it (11 below)
11. Cancel emergency
-the driver can cancel the emergency by checking-in
-the employer can cancel the emergency

2.3 Functional Flow Diagram

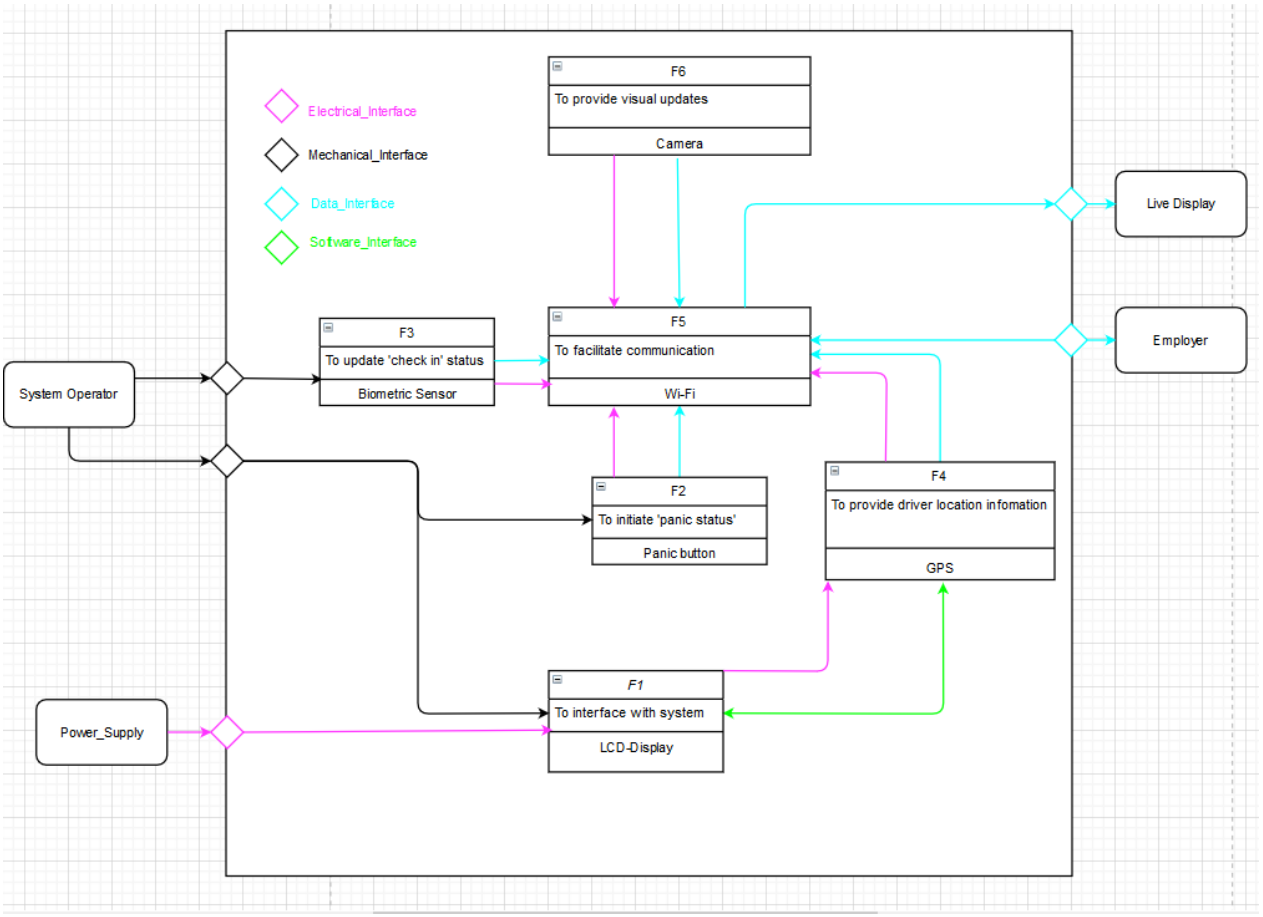

Figure 3: The Functional Flow Diagram outlining system functions