

Department of Computer Information Systems

King Abdullah II School for Information Technology

The University of Jordan

**BRT cameras**

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# Executive Summary:

Our software project aims to improve the efficiency and safety of a dedicated bus lane using cameras mounted on traffic lights. The system will detect the presence of buses and count the number of passengers to optimize the traffic signal timings and provide real-time updates to passengers on the nearest bus and its arrival time. Additionally, the cameras can be used to perform other functions such as bus tracking, passenger counting, security monitoring, road maintenance, and environmental monitoring. By utilizing the available technology and data, the traffic management system can make informed decisions to improve the bus service, reduce congestion, and enhance the overall experience for passengers and drivers alike.

# Introduction:

## Project Overview

The goal of this project is to develop a traffic management software system for a dedicated bus lane using cameras mounted on traffic lights. The system will detect the presence of buses and count the number of passengers to optimize the traffic signal timings and provide real-time updates to passengers on the nearest bus and its arrival time.

## The purpose of the Project

The traffic management software project aims to improve the efficiency and safety of a dedicated bus lane through a system that utilizes cameras mounted on traffic lights to optimize traffic signal timings, detect buses, count passenger numbers, and provide real-time updates. Existing systems often rely on outdated technology and fixed-time signal plans, resulting in delays and congestion. The goal is to enhance user experience, reduce congestion, and improve efficiency and safety while ensuring flexibility and adaptability to changes in traffic flow and stakeholder needs.

## The Scope of the Work and Project Deliverables

**Business Requirements:**

The traffic management software system should be designed to achieve the following business requirements:

* Detect the presence of buses in a dedicated bus lane.
* Count the number of passengers on each bus.
* Optimize the frequency and capacity of buses based on passenger counts.
* Provide real-time updates to passengers on the nearest bus and its arrival time.
* Enhance overall user experience in the dedicated bus lane.
* Reduce congestion and improve the efficiency and safety of the bus lane.

**Constraints:**

* The software must be designed to work with the existing traffic infrastructure.
* The system must comply with local traffic laws and regulations.
* The software must be reliable, secure, and easy to use.
* The system should be cost-effective and easy to maintain.

**Solution Alternatives:**

There are different solution alternatives to consider when developing the traffic management software system, including:

* Using advanced cameras and sensors to detect the presence of buses and count passenger numbers
* Integrating with existing traffic management systems to optimize traffic signal timings.
* Utilizing machine learning algorithms to adapt the system to changing traffic conditions

**Proposed Solution:**

The proposed solution is to develop a system that utilizes cameras mounted on traffic lights to detect the presence of buses, count passenger numbers, and optimize the frequency and capacity of buses. The software will integrate with existing traffic management systems to optimize traffic signal timings, and machine learning algorithms will be used to adapt the system to changing traffic conditions. The software will provide real-time updates to passengers on the nearest bus and its arrival time, enhancing overall user experience in the dedicated bus lane while reducing congestion and improving the efficiency and safety of the bus lane.

## 1.4Local and Global Impact of The Proposed Solution

**Local Impact:**

Improved user experience and reduced travel times for commuters using the dedicated bus lane, leading to increased ridership and reduced congestion.

Improved safety and reduced accidents in the dedicated bus lane, leading to fewer injuries and fatalities.

Reduced greenhouse gas emissions due to more efficient bus scheduling and reduced traffic congestion.

**Global Impact:**

Increased adoption of smart traffic management solutions can lead to improved traffic management and reduced congestion in urban areas globally.

Reduced greenhouse gas emissions from more efficient traffic management can help reduce the carbon footprint of transportation and contribute to global efforts to combat climate change.

Improved safety of transportation systems in urban areas can reduce the number of traffic-related injuries and fatalities globally.

Overall, the proposed traffic management software solution can have significant positive impacts both locally and globally by improving traffic management, reducing congestion, increasing safety, and reducing greenhouse gas emissions.

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## 1.5Naming Conventions and Definitions (Terms, Acronyms, and Abbreviations)

Terms:

* Traffic management software: A system that utilizes cameras mounted on traffic lights to optimize traffic signal timings, detect buses, count passenger numbers, optimize bus frequency and capacity, and provide real-time updates.
* Dedicated bus lane: A road lane that is reserved exclusively for buses.
* Machine learning: A type of artificial intelligence that enables computers to learn and improve performance on a specific task without being explicitly programmed.
* User experience: The overall experience of a person using a product or service, including ease of use, efficiency, and satisfaction.

Acronyms and Abbreviations:

* BRT: Bus Rapid Transit
* CCTV: Closed-circuit television
* GPS: Global Positioning System
* IoT: Internet of Things
* API: Application Programming Interface
* ML: Machine Learning

# 2.0 Feasibility Study

## 2.1 Technical Feasibility

1. Camera Placement and Coverage: The project requires cameras to be mounted on traffic lights to detect buses and count passenger numbers. The placement of cameras and their coverage area must be carefully planned to ensure accurate detection and counting.
2. Image Processing: The system must be able to process camera images in real-time using machine learning algorithms to detect buses and count passengers. This requires the use of high-performance computing devices and specialized software libraries for image processing and machine learning.
3. Data Security: The system will collect sensitive data such as bus schedules, passenger counts, and traffic signal timings. Robust security measures must be implemented to protect this data from unauthorized access, breaches, and cyber-attacks.
4. System Maintenance: The system must be regularly maintained to ensure proper functioning and accuracy. This includes software updates, hardware maintenance, and regular checks on the camera and sensor systems.
5. User Interface: The system should have an easy-to-use user interface to allow operators to access and analyze real-time data, manage bus schedules, and adjust the system as needed.

## 

## 2.2perational Feasibility

1. User Acceptance: The project aims to improve the traffic flow and provide real-time bus schedules to passengers. Therefore, it is essential to involve bus drivers, passengers, and traffic management officials in the project planning process to ensure that the system meets their needs and expectations.
2. Staff Training: The successful implementation of the project requires staff to be trained to operate and maintain the system. Bus drivers and traffic management officials will need to be trained on how to use the system, interpret data, and respond to system alerts.
3. System Integration: The system should be integrated with existing traffic management systems to ensure seamless operation and minimize disruption to existing operations. This includes the integration with traffic signal control systems and communication systems.
4. Cost-Effectiveness: The project should be cost-effective, with benefits outweighing the cost of implementation and maintenance. This requires a careful analysis of the costs and benefits of the project, including the cost of hardware and software, installation and maintenance costs, and potential cost savings from improved traffic flow.
5. Legal and Regulatory Compliance: The system must comply with relevant laws and regulations, including data protection laws and traffic regulations.

## 

## 2.3 Economic Feasibility

**1-Totel Economic Cost:**

**2-Expenses Costs :**

|  |  |  |
| --- | --- | --- |
|  | Cost | Number |
| Camera equipment costs | **70 JD** | **1 camera** |
| Installation costs | **150JD** | **1 camera** |
| System integration costs | **1000JD** | **All system** |
| Maintenance and operation costs | **75JD** | **1 camera** |
| Training and manpower costs: | **300 JD** | **1 camera** |
| Potential revenue sharing or usage fees | **100** | **1 camera** |
| Regulatory compliance costs | **150** | **1 camera** |
|  |  |  |

* **Totel costs for eache camera :**
* 70 + 150+ 75 + 300 + 100 + 150 = 845
* + the system integration 100000
* **Expenses:**

Annual maintenance: 500 JD/ C

Ensure that the system work: 300 JD.

Total = 800 JD .

**-Development Cost:**

**-Personal Costs**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| 1 System Analyst | **30 JD** | **20 hr** | **600 JD** |
| 1 System Administrator | **16 JD** | **30 hr** | **480 JD** |
| 2 Programmer | **15 JD** | **130 hr** | **1950 JD** |
| 1 GUI designer | **10 JD** | **25 hr** | **250 JD** |
| 1 Database Specialist | **10 JD** | **15 hr** | **150 JD** |
| Total : 3430 JD |

|  |  |
| --- | --- |
| Hardware & Software | **Cost** |
| **1 Computers** | **750 JD** |
| **1 DBMS Software** | **450 JD** |
| **1 Development Server** | **700 JD** |
| **Total** | **1900 JD** |

## 2.4 Schedule Feasibility

Any delay after the deadline will result in the entire project being rejected. Therefore, feasibility scheduling in this case is a very important factor. Accordingly, our site requirements have been carefully defined so that we can implement the project within the acceptable time frame granted to us.

## 2.5 Legal Feasibility

1. Data Protection: The project must comply with the Personal Data Protection Law No. 30 of 2018 in Jordan, which governs the collection, processing, storage, and use of personal data. The law requires obtaining consent for data processing, implementing appropriate security measures, and notifying data subjects of any breaches.
2. Intellectual Property Rights: The project must respect intellectual property rights in Jordan, which are governed by the Jordanian Copyright Law and the Jordanian Trademark Law. The laws provide for the registration and protection of copyrights and trademarks, and any use of third-party intellectual property must be properly licensed and authorized.
3. Liability and Responsibility: The project should define liability and responsibility for any potential accidents, damages, or other issues that may arise from the use of the system, in accordance with Jordanian civil law. The system operators, maintenance personnel, and other stakeholders must comply with relevant regulations and standards.
4. Compliance with Traffic Regulations: The project must comply with relevant traffic regulations in Jordan, which are governed by the Jordanian Traffic Law. The law regulates traffic signal control, pedestrian safety, and other aspects of traffic management, and the system should be designed to enhance safety and efficiency on the road while complying with relevant regulations.
5. Accessibility: The project must ensure accessibility for all users in Jordan, including individuals with disabilities, in accordance with the Jordanian Persons with Disabilities Law No. 20 of 2017. The law requires public facilities and services to be accessible to individuals with disabilities, and the traffic management software project should comply with these requirements.

# 3.0 Project Management plan

## 3.1 Project Organization

1. Project Sponsor: This is the person or group that provides the funding and support for the project. They oversee the project and ensure that it aligns with the business objectives.
2. Project Manager: This is the person responsible for managing the project and ensuring that it is delivered on time, within budget, and to the required quality standards. They are responsible for communication with stakeholders, risk management, and project reporting.
3. Technical Team: This team is responsible for developing and implementing the software solution. It may include software engineers, data analysts, user interface designers, and other technical specialists.
4. Operations Team: This team is responsible for maintaining and supporting the software solution after it has been implemented. It may include system administrators, technical support specialists, and other operations personnel.
5. Stakeholders: This includes all individuals or groups who have an interest or are affected by the project, including government agencies, transportation authorities, bus operators, and the public.

## 

## 3.2 roles and responsibilities

|  |  |
| --- | --- |
| **role** | Description |
| Project Manager | responsible for overall project management, including planning, scheduling, budgeting, and risk management. |
| Software Developer | responsible for designing, developing, and testing software solutions that meet project requirements. |
| Hardware Engineer | responsible for designing, implementing, and maintaining the hardware infrastructure needed for the project. |
| Data Analyst | responsible for analyzing and interpreting data collected by the cameras and providing insights to optimize traffic flow. |
| Quality Assurance (QA) Specialist | responsible for ensuring that the software solution meets quality standards and performs as expected. |
| User Experience (UX) Designer | responsible for designing and testing the user interface to ensure that it is intuitive and easy to use. |
| Deployment Engineer | responsible for deploying the software solution and ensuring that it is properly integrated with the hardware infrastructure. |
| Technical Writer | responsible for documenting the software solution, including user manuals, technical specifications, and system documentation. |

## 3.3 Software Process Model

Agile model is based on iterative and incremental development, with a focus on delivering working software in short cycles. This approach allows for continuous feedback and adjustments to be made throughout the development process, making it easier to adapt to changing requirements or new information.

In an Agile model, the development team works closely with stakeholders, such as end-users, to ensure that the system meets their needs and expectations. The team collaborates on the development of user stories, which describe the desired functionality of the system from the user's perspective. These user stories are then used to prioritize development tasks and guide the iterative development process.

Agile also emphasizes frequent testing and quality assurance, with the goal of catching and addressing issues early in the development process. Testing is integrated throughout the development process, with automated testing tools used to help identify and resolve defects quickly.

Overall, the Agile model can help ensure that your project is completed on time, within budget, and with high quality. However, it's important to keep in mind that Agile requires a high degree of collaboration and communication among team members, as well as a willingness to adapt to changing requirements or feedback.

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## 3.4Tools and Techniques

|  |
| --- |
| Computer vision libraries and frameworks: Your project involves using cameras to detect buses and count the number of passengers, so you will need to use computer vision libraries and frameworks such as OpenCV or TensorFlow. |
| Traffic simulation software: You may want to use traffic simulation software like SUMO or VISSIM to model the traffic flow and test your solution before deploying it in the real world. |
| GPS and mapping APIs: To provide users with information about the nearest bus and estimated arrival time, you may want to use GPS and mapping APIs like Google Maps or Mapbox. |
| Database management systems: You will need a database management system to store information about the buses, their routes, and passenger counts. Popular options include MySQL, PostgreSQL, or MongoDB. |
| Real-time messaging platforms: You may want to use a real-time messaging platform like MQTT or WebSockets to provide real-time updates to users about bus arrival times. |
| Continuous Integration/Continuous Delivery (CI/CD) tools: CI/CD tools like Jenkins or GitLab can be used to automate the software build, testing, and deployment process. |
| Agile development methodologies: Agile methodologies like Scrum or Kanban can be used to manage the development process and ensure that the project is meeting its objectives. |

## 3.5 Work breakdown

### 3.5.n Project Tasks

|  |  |  |
| --- | --- | --- |
| Task number | Task | Description |
| T1 | Idea gathering | This task involves brainstorming and researching to generate and refine your project idea. |
| T2 | Feasibility study | This task involves assessing the technical, operational, economic, and legal feasibility of the project to determine if it is viable. |
| T3 | Gathering requirements | This task involves identifying and documenting the specific features and functionality that the system should have to meet the needs of users. |
| T4 | System analysis | This task involves analyzing the requirements and identifying any potential issues or challenges that may arise during development. |
| T5 | System design | This task involves creating a high-level design for the system, including the architecture, components, and interfaces. |
| T6 | Implementation | This task involves writing and testing the code for the system components and integrating them into a functional system. |
| T7 | Testing | This task involves testing the system to ensure that it meets the requirements and functions as expected. |
| T8 | Maintenance and support | This task involves providing ongoing maintenance and support to the system to ensure that it continues to function properly and meet the needs of users. |

### 3.2.2 Deliverables and Milestones

**Deliverables:**

* Feasibility study report
* Requirements document
* System design document
* Source code and documentation
* User manual and training materials
* Testing and validation reports
* Final project report

**Milestones:**

* Completion of feasibility study and approval of project plan
* Completion of requirements gathering and approval of requirements document
* Completion of system analysis and design and approval of system design document
* Completion of implementation and testing of system components
* Completion of system testing and validation
* User acceptance testing and approval.
* Project completion and final report submission

### 3.2.3 Resources needed (Skills, HW and SW)

**Skills**:

* Software development skills (e.g., programming, software design, testing, documentation)
* Systems analysis and design skills
* Project management skills
* Knowledge of computer networks and communication protocols
* Understanding of image and video processing techniques

**Hardware:**

* Cameras for detecting buses and tracking traffic
* Server or cloud infrastructure for processing data and running the system.
* Network infrastructure for communication between cameras and servers

**Software:**

* Integrated Development Environment (IDE) for programming (e.g. Eclipse, Visual Studio)
* Image and video processing software (e.g., OpenCV, Matlab)
* Database management system (e.g., MySQL, Oracle)
* Web development frameworks (e.g., Node.js, React)

### 3.2.4 Dependencies and Constraints

**Dependencies:**

|  |
| --- |
| * Availability of necessary hardware, software, and skills |
| * Availability of power and internet connectivity |
| * Collaboration and communication between team members |
| * Compliance with relevant legal and regulatory requirements |
| * Availability of funding and other resources |

**Constraints:**

|  |
| --- |
| * Time constraints for project completion |
| * Budget constraints for acquiring necessary resources |
| * Technical limitations of hardware and software |
| * Physical constraints of the environment (e.g., weather, traffic conditions) |
| * Compatibility issues between different hardware and software components |

## 

## 3.6 Assigning Team Members To Tasks

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tasks | Description | Start time | Duration | Dependcies | Staff |
| T1 | Starting the project | 3 Apr | 10 Days | None | All members |
| T2 | Technical & operational feasibility | 13 Apr | 7 Days | T1, (M1) | Anan, Yazan |
| T3 | Economic & Schedule Feasibility | 20 Apr | 7 Days | M1 | Omar, Zaid |
| T4 | Identifying Stakeholder & Data gathering techniques | 25 Apr | 5 Days | T2, T3, (M2) | Talal, Zaid, Anan |
| T5 | Functional & Nonfunctional requirements & Domain | 30 Apr | 12Days | T4, (M3) | All Members |
| T6 | Risk Management | 12 May | 9 Days | M3 | Zaid |
| T7 | System Modeling | 21 May | 15 Days | T5 | All members |
| T8 | Implementation | 5 June | 10 Days | T7 | Yazan, Zaid, Anan |
|  |  |  |  |  |  |

* The project should be done in duration of 70 Days.

## 3.7 project schedule

1.. Pert Diagram:

Diagram, engineering drawing

Description automatically generated

3.Gant Chart:

Chart, timeline

Description automatically generated

Figure 2 Grant chart

## 3.8 Risk analysis

|  |  |  |
| --- | --- | --- |
| Risk | Probability | Effect |
| Organizational financial problem | Moderate | Serious |
| Find qualified cloud developers is not an easy thing. | High | Tolerable |
| Changes to requirements that require major design rework | Very high | Serious |
| The time required to develop the software is underestimated | High | Serious |
| The size of the software is underestimated | Low | Serious |
| Open sources libraries may not cover software needs or have security defects. | High | Tolerable. |
| Privacy and security risks the system could be vulnerable to cyber-attacks or  unauthorized access, | Low | Serious. |
| Officers may face difficulties in using the system properly. | Low | Tolerable. |
| Operational risks | Low | Serious |
| Stakeholder risks: bus drivers, passengers, or community members. | Low | Serious |

## 

## 3.9 Monitoring, reporting, and controlling mechanisms for my project.

1. Regular team meetings to review progress, identify issues, and discuss potential solutions.
2. Milestone tracking to ensure that the project is progressing as planned.
3. Use of project management software to track progress and communicate with team members.
4. Communication with stakeholders, including regular updates on project status and any issues or risks identified.
5. Regular review of project deliverables to ensure they meet quality standards.
6. Use of change management processes to manage changes to project scope or requirements.
7. Use of risk management processes to identify and mitigate project risks.