

GARAGE DOOR OPENER
BASED ON IMAGE
PROCESSING

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Outline

- Introduction
- Problem Statement
- Project Requirement
- Project Specification
- System Design
- Progress

Introduction

Problem Statement

- Design and implementation of a garage door opener. Unlike a traditional garage opener that uses a remote control, the system analyses images of approaching cars and opens the door when a recognised car plate is identified.
- Negative Impacts



Project Requirement

- Should open the gate in a short time.
- Notify the user when recognition is succeed or failed.
- An automation for exiting the garage.
- Securely identification for the owner.
- Enough time between opening and closing safely.

Project Specifications

- Stay ideal until car approaches the garage.
- Take a photo for the plate when the car is close to the garage.
- Processing the photo should take maximum of 3 seconds.
- If a plate is recognise a green lamp will turn on to notify the user.
- If a plate is not recognise a red lamp will turn on to notify the user.
- There will be sensors on the other side of the garage for auto opening
- There will be a photo for each car that has a specific plate to compare it for later attempting to help in identify fake attempts.
- The garage will stay open for five second to allow until the car fully enter.

System Design

- Architecture
- Component and Implementation
- System Integration
- Design Decisions
 - Tradeoff

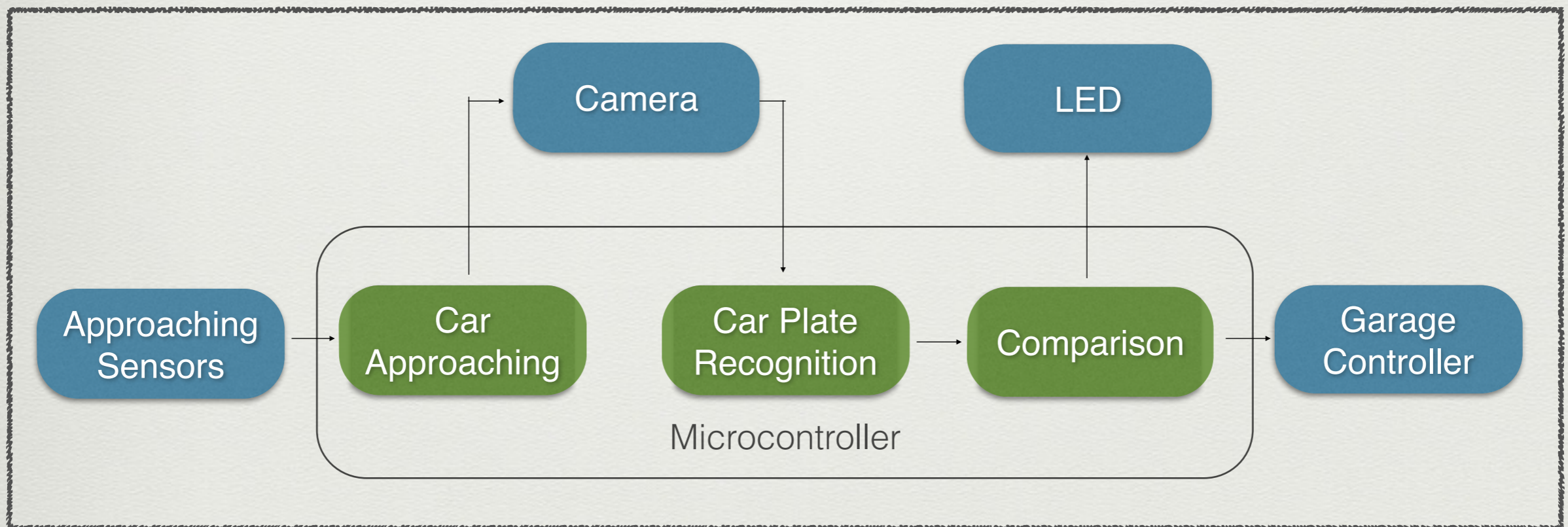


Architecture

- Entering Mode
- Exiting Mode
- **NOTE:** The entities that are inside the micro-controller are software components and the others are hardware components.

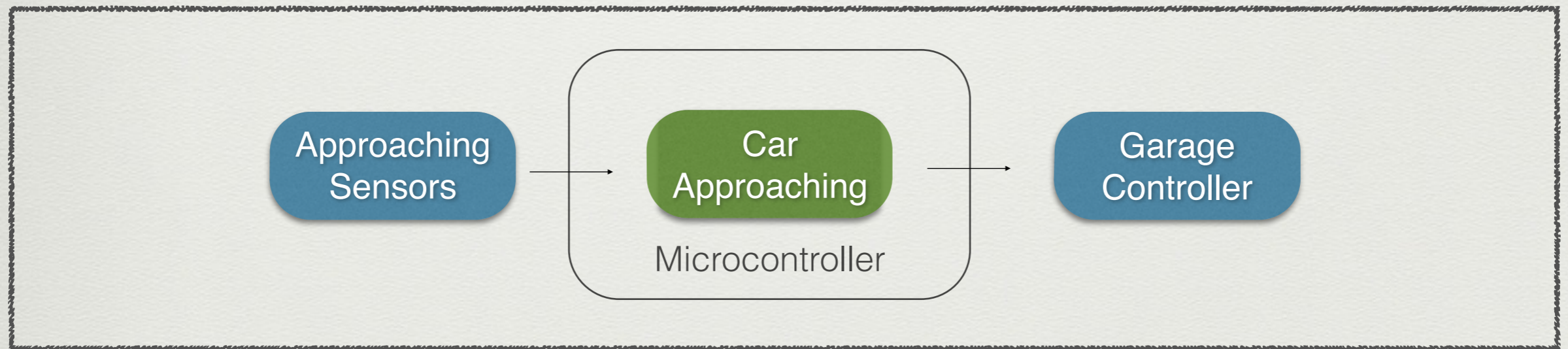
Entering Mode

This mode is responsible of opening the gate, to allow a car to enter. When a car is approaching the garage, the system will take a picture of the car and then process it to get the plate information. Then compare it with registered plates to approve or disapprove it, and send a signal to the garage controller to open, if approved.



Entering Mode

This mode is responsible of opening the gate to allow the car to exit from the garage. If a car is close to the gate form the back, then the gate will open for exiting.



Component and Implementation - Hardware Components

- *Approaching Sensors* : Its main job is to notify the system that a car is approaching the garage.
- *Camera* : The camera will capture an image of the plate.
- *LED* : Turn on to inform the user if a car has been recognised or not and the mode if it is in Entering or Exiting Mode.
- *Garage Controller* : The controller that controls the garage either open or close it

Approaching
Sensors

Camera

LED

Garage
Controller

Component and Implementation - Software Components

- *Car Approaching* : To tell the system that a car is on the right place to take a picture.
- *Car Plate Recognition* : Takes an image as an input and process it to recognise the letters and numbers of the plate, and outputs a plain text.
- *Comparison* : Comparing the text, the output of Car Plate Recognition, with the registered ones.

Car
Approaching

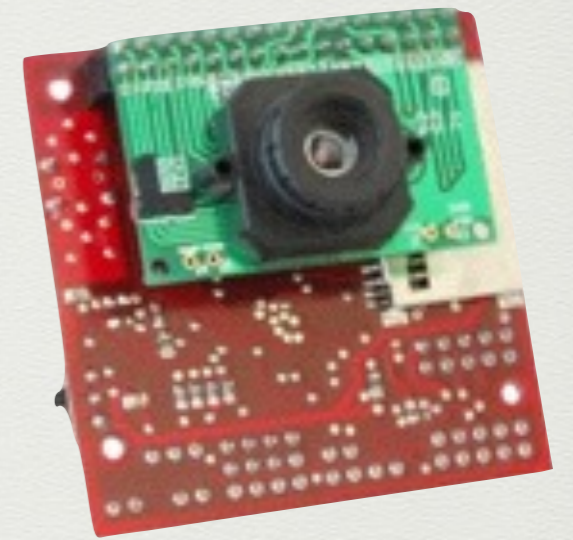
Car Plate
Recognition

Comparison

Component and Implementation - Physical Components

- *CMUcam3*

It is an ARM based fully programmable embedded computer vision sensor. This part is responsible for capturing the image and process it and sending a plain text, plate's numbers and letters. to Arduino, through serial port



Camera

Car Plate
Recognition

Component and Implementation - Physical Components

- *Arduino UNO*

It is a single-board micro-controller, This board is the heart of the project. It gets the information from the approaching sensors and then send a signal to CMUcam3 to capture the image and analyses it to get the plain text, then compare it with the registered plates. Then if approved, a LED will turn on and a signal will send to the garage controller.



Car
Approaching

Comparison

Component and Implementation - Physical Components

- *Ultrasonic Sensors*

This sensors will be connected to Arduino to sense if a car is approaching.

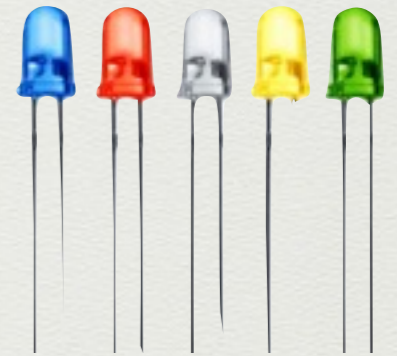


Approaching
Sensors

Component and Implementation - Physical Components

- *LEDs*

LED will be used to notify the user if the plate is recognised or not and also for identifying the mode and as the garage controller for telling the state of the garage, opening and closing .



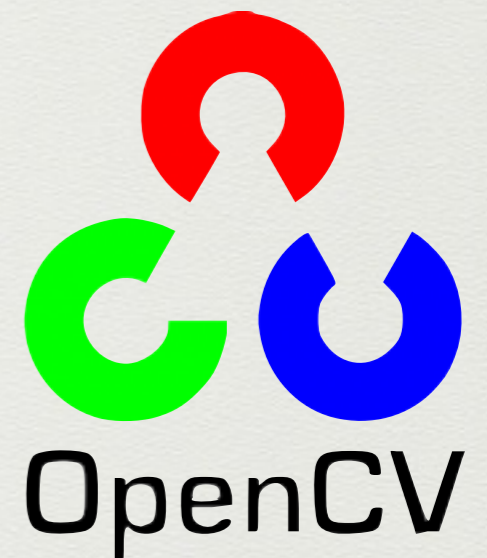
LED

Garage
Controller

Component and Implementation - Software Packages

- *OpenCV*

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision, It is free for use under the open source BSD license. The library is cross-platform. It focuses mainly on real-time image processing. it will be integrated in CMUcam3, since it is the part for processing the image. Use it to focus on the plate itself and on identifying fake attempting.



- *Tesseract*

It is an optical character recognition engine for various operating systems. It is free software. It will also run in CMUcam3. to recognise the letters and numbers on the plate.

Car Plate
Recognition

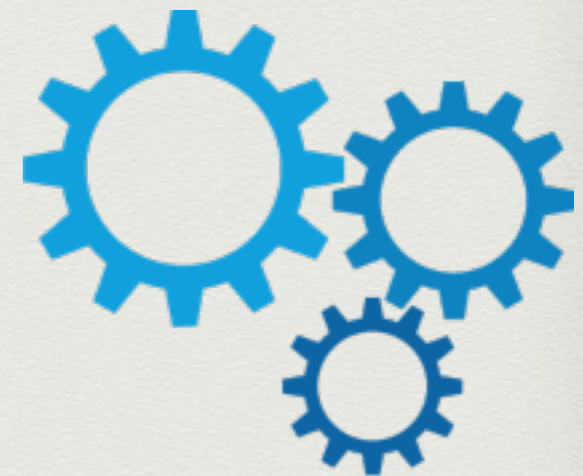
System Integration

Since Arduino is the heart of the project, everything will connect to it, CMUcam3 with serial port and the others, LEDs and ultrasonic sensors, through pins. CMUcam3 will have the image processing software, OpenCV and Tesseract.



The first step of implantation is to install all software components on CMUcam3 to test it.

Then programming both, Arduino and CMUcam3, for communicate through the serial port.



Finalise the implantation part for testing.

Design Decisions

- This system uses CMUcam3 as an image processing unit, since it has a powerful processor and API that deals with images easily, and it is cheap and available. Arduino, because it is cheap and easy to program. Other parts are also cheap and available. Software packages are being used since it is an open source software.
- Tradeoff

The system can use either Arduino or Raspberry as microprocessor but I chose Arduino based on the table below. Arduino is small, cheaper and it has enough RAM, less power consumption and it has analog inputs that will be used with the approaching sensors. For CMUcam3, I chose it since it is already available to use right now.

Microcontroller	Price	Size	Ram	Min Power	Analog inputs	Experience
Arduino UNO	~29\$	2.95"x2.11"	2 KB	42 mA (0.3w)	Yes	Yes
Raspberry Pi	~35\$	3.37"x2.125"	256 MB	700 mA (3.5w)	N/A	Not

Progress

- Task Schedule

Tasks	Description	Week
Collecting part	Collecting physical and software parts.	Week 8,9
Implementation on CMUcam3	installing needed software on the chip and testing it.	Week 9,10
Connecting the parts	Connecting the microcontrollers, LEDs and approaching sensors.	Week 11,12
Testing the prototype	testing the system.	Week 14
Solving other problems	Solving other problems like fake attempting and others.	Week 15

- Completed Task

Questions

Thanks For Listening!

