AUTOMATED VEHICLE PARKING AND TRACKING IN GARAGE USING EMBEDDED CAMERA SYSTEM

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Abstract—In this study, we present a new indoor positioning and environment perception system for generic objects based on multiple surveillance cameras. In order to assist highly automated driving, our system detects the vehicle's position and any object along its current path to avoid collisions. A main advantage of the proposed approach is the usage of cameras that are already installed in the majority of parking garages. We generate precise object hypotheses in 3D world coordinates based on a given extrinsic camera calibration. Starting with a background subtraction algorithm for the segmentation of each camera image, we propose a robust view ray intersection approach that enables the system to match and triangulate segmented hypotheses from all cameras. Comparing with LIDAR-based ground truth, we were able to evaluate the system's mean localization accuracy of 0.37m for a variety of different sequences.

Key words: LPC2148,

I.   Introduction

In this study, we introduce an infrastructural embedded approach for localization and tracking of generic objects for indoor environments. We focus on the example of parking garages to establish a positioning system in the context of autonomous driving. Its main target is to detect and track vehicles and secondary objects along its current path. Due to the lack of GPS information and non-sufficient on-board vehicle sensors an infrastructural system which communicates with the autonomously driving car has

to be precise, reliable and real time capable. If an object crosses the path of the vehicle, the system has to raise a warning to avoid a collision. Because arbitrary objects (e.g., other vehicles, small / tall humans, bicycles, or animals) should be recognized by the system, size and shape constraints are ignored. To achieve these aims, we use surveillance cameras already installed in the majority of the parking garages and extend their purpose to an external vehicle localization system. Thus, the approach is inexpensive, does not require additional hardware except the infrastructural car-to-environment communication, and is transferable to other indoor scenarios, e.g., tunnels, factories etc.

II.   The Hardware System

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid

crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

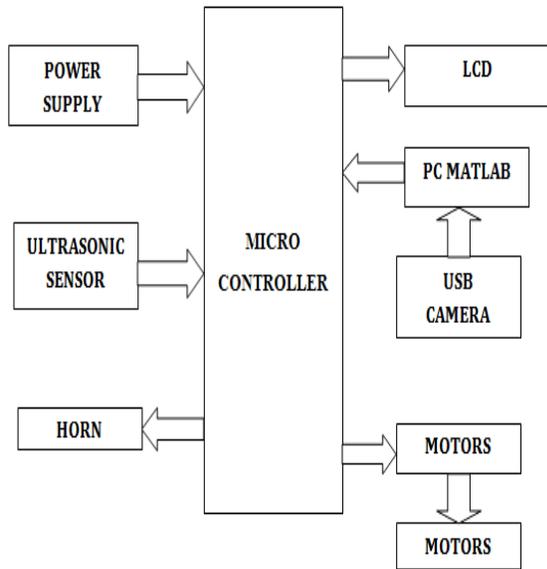### III.   Design of Proposed Hardware System

Fig.1. Block Diagram

In this approach the usage of cameras that are already installed in the majority of parking garages. We generate precise object hypotheses in 3D world coordinates based on a given extrinsic camera calibration. Starting with a background subtraction algorithm for the segmentation of each camera image Along with that we place a ultrasonic sensor which will calculates the obstacle if any obstacle detected within short range then vehicle is stopped and camera is turned on and image is given to mat lab for processing to predict the position and motion of person. If person is moving means car will be started if person is idle means car will stops and blows a horn.

IV.   Board Hardware Resources Features

The major components used in our project are to capture images infront of vehicle and to sense the distance between object and vehicle are shown below:

Ultrasonic Distance Sensor

Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping.

Features

· Minimum range 10 centimeters
· Maximum range 400 centimeters (4 Meters)
· Accuracy of +-1 cm
· Resolution 1 cm
· 5V DC Supply voltage
· Compact sized SMD design
· Modulated at 40 kHz
· Serial data of 9600 bps TTL level output for easy interface with any microcontroller

MATLAB COMPUTER:

MATLAB (**mat**rix **lab**oratory) is a multi-paradigm numerical computing environment and fourth generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, Fortran and Python. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi-domain simulation and Model-Based Design for dynamic and embedded systems. In 2004, MATLAB had around one million users across industry and academia. MATLAB users come from various backgrounds of engineering, science, and economics. MATLAB is widely used in academic and research institutions as well as industrial enterprises.

USB CAMERA:

USB Cameras are imaging cameras that use USB 2.0 or USB 3.0 technology to transfer image data. USB Cameras are designed to easily interface with dedicated computer systems by using the same USB technology that is found on most computers. The accessibility of USB technology in computer systems as well as the 480 Mb/s transfer rate of USB 2.0 makes USB Cameras ideal for many imaging applications. An increasing selection of USB 3.0 Cameras is also available with data transfer rates of up to 5 Gb/s. Edmund Optics offers a variety of USB Cameras suited to meet many imaging needs. EO USB Cameras are available in both CMOS as well as CCD sensor types making them suitable across a larger range of applications. USB Cameras contain out-of-the-box functionality for quick setup. USB Cameras using low power USB ports, such as on a laptop, may require a separate power supply for operation.

V. Conclusion

This study presents an indoor positioning system for generic objects by means of a camera network. Objects are segmented using a background representation. To generate precise and plausible world hypotheses we intersect view rays of these objects and track them in a world representation. We focus on the detection of generic objects of arbitrary size which can be performed without prior training. Similar camera-based systems proposed in the literature report higher deviation, with a positioning error of 1m.

However, our system is indeed precise enough to locate an object for applications like collision warning. We also want to point out that the proposed system is based on surveillance cameras, a majority of modern parking decks are equipped with. Therefore, it does not require additional hardware expense. In the future, we want to investigate refinements of the image processing pipeline to handle remaining drawbacks we have identified. The effect of strong light sources needs to be reduced by further segmentation methods. The problem of overlapping objects in a single ROI – which occurred in only one camera image – has to be analyzed more deeply and can be solved by extending the proposed triangulation method.

VI. REFERENCES

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