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Intelligent Automated Sliding Door Robot Control System

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Abstract:

A location-aware news feed (LANF) system generates news feeds for a mobile user based on her spatial preference her current location and future locations) and non-spatial preference (i.e., her interest). Existing LANF systems simply send the most relevant geo-tagged messages to their users. Unfortunately, the major limitation of such an existing approach is that, a news feed may contain messages related to the same location (i.e., point-of-interest) or the same category of locations (e.g., food, entertainment or sport). We argue that diversity is a very important feature for location-aware news feeds because it helps users discover new places and activities.

In this paper, we propose D-MobiFeed; a new LANF system enables a user to specify the minimum number of message categories (h) for the messages in a news feed. In D-MobiFeed, our objective is to efficiently schedule news feeds for a mobile user at her current and predicted locations, such that (i) each news feed contains messages belonging to at least h different categories, and (ii) their total relevance to the user is maximized. To achieve this objective, we formulate the problem into two parts, namely, a decision problem and an optimization problem. For the decision problem, we provide an exact solution by modeling it as a maximum flow problem and proving its correctness. The optimization problem is solved by our proposed three-stage heuristic algorithm.

We conduct a user study and experiments to evaluate the performance of D-MobiFeed using a real data set crawled from Foursquare. Experimental results show that our proposed three-stage heuristic scheduling algorithm outperforms the brute-force optimal algorithm by at least an order of magnitude in terms of running time and the relative error incurred by the heuristic algorithm is below 1%. D-MobiFeed with the location prediction method effectively improves the relevance, diversity, and efficiency of news feeds.

Keywords—***Location-Aware News Feed (LANF), D-MobiFeed. diversity control, sensor based control, heuristic algorithm.***

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I. INTRODUCTION

Automatic door systems are installed at many places such as shopping malls, airports, office places, etc. Typical automatic sliding door is as shown in Fig. 1.1. These doors open automatically when presence of one or many people is detected. If the door is installed at public places, the door opens for everyone, and if it is installed at private places with restricted access, then some form of access control mechanism is employed.

The presence sensors are generally placed at the top of the doors, which continuously scan the detection region. When the system is installed at the user's space, various settings of the door such as door opening width, opening time, opening and closing speeds are fixed. If the user wants to alter the door settings, the user has to call a technician to do the necessary changes. Problem with this is that the user has to bear the expenses of technician's visit, every time the door settings need to be altered. Presents an intelligent automatic door system, in which the users can do the changes by themselves.

1.1 Over View of The System

As explained in the previous section, the user can be benefitted by using a handheld device which can communicate with the door system in wireless manner. Access control mechanism can be implemented to allow only authorized persons to enter through the door. This can be achieved through various techniques such as voice recognition, face recognition, iris recognition password-based systems, smart cards etc.

We have used NFC smart card based approach as it provides necessary access control with computational needs very less than voice and iris recognition type of systems. Only the users with valid and authorized cards can pass through the door. This is useful to keep a track of employee's attendance record within an institution. The

designed system is able to operate both as a public place door (without authentication), and as a private place door (with authentication). Some of the conventional door systems use infrared sensors for detecting a human presence, while other use Doppler Effect sensors for detecting motion. Infrared sensors cannot detect motion.

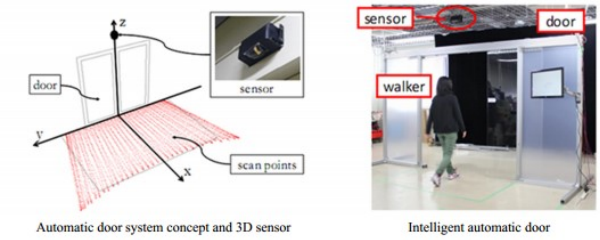


Figure 1.1: Automated Door System Concept And 3d Sensor

The sliding door assembly is coupled with the DC motor shaft through a belt drive. As the motor rotates, the circular motion of motor shaft is converted into linear motion of sliding door. The positioning of the door system is detected through limit switches, and the feedback signal received from the motor. For generating a feedback signal, the motor is equipped with an optical Quadrature encoder mounted on its shaft.

As the motor rotates, it generates a signal in the form of two identical square wave signals, which are phase shifted by 90 degrees. These two signals can be used to derive the direction of rotation of the motor, depending on which of the two signals is leading over the other. The microcontroller LPC 1769 has a special peripheral known as Quadrature Encoder Interface (QEI).

1.2 Motivation

The main motivation for this dissertation points out the weaknesses of today's automated sliding doors in the context of ambient intelligent systems, and outlines the challenges of interpreting human intentions. The work of feature extraction within the computer vision field is, although not trivial, a well-known task. The connection between these features and human intentions, however, is not.

Comparator

Comparator compares the analogue inputs from the sensors with a fixed reference voltage. If this voltage is higher than the reference voltage than comparator outputs a low voltage and if the voltage is lower than the reference voltage than it outputs a high voltage to the decision making element that is the microcontroller. The IC used of the comparator is LM358N.

Microcontroller

Microcontroller is pre-programmed to turn on the motors or supply required current and voltage to motors only if the condition is fulfilled. Microcontroller check when the output of comparator is low it turns the motor on as the path between receiver and transmitter is broken due to some obstacle between them.

Motor Driver (Open and Close)

The current supplied by the microcontroller to is not sufficient to drive the motor. Thus motor driver provides sufficient current to run motor. It can take a maximum current of 600mA per channel which is more than enough to drive two motors. The IC used for it is L293D.

II LITERATURE REVIEW

2.1 Development of Intelligent Automatic Door System

- Conventional automatic doors cannot distinguish between people wishing to pass through the door and people passing by the door, so they often open unnecessarily.
- An intelligent door system that observes people near a door so that the door opens at the proper time and only for people who have the intention of passing through it.
- We developed a novel laser range scanner that scans the surrounding environment three dimensionally, and formulated lightweight algorithms for the sensor.
- The experimental results show that the sensor can control a door according to the speed of people within the required specifications and that it correctly identifies people passing by the door.

Advantages

- The advantages of high precision, safety, reliability, and can be responsive to demands.
- The benefits of being low cost and high added value.
- It is noted that the system has advantages of low false rate (near 0%), high correct activating rate (99.6%), and short response time (within 2 s) from detecting the target.

Disadvantages

- This approach is accurate and capable of identifying the position and the speed of the object but its high cost has made it less popular.

2.2 Motion States Recognition System Based On Ultrasound for Automatic Door Management

- The paper describes a novel motion states recognition system based on ultrasound to make up for the shortcomings of existing motion states recognition systems.

- The motion states of people beside the door can be identified quickly and exactly by motion states recognition algorithm based on Doppler Effect.
- The ultrasonic sensor gives a good performance on anti-interference in addition to its low energy consumption and price.
- Therefore, using ultrasonic probes can improve the performance of the system while reducing the cost.

Advantages:

- A low cost solution to wireless attendance management and access control problems.
- The design is based on the integration of AT89C52 microcontroller and commercially available wireless door bell.
- The overall cost of the system can be reduced if readily available low cost off-the-shelf components are used in developing the system.

Disadvantages:

- These systems, though efficient, do not present a cost effective solution to the office automation problem.

2.3 An Access System for Buildings Based On Smart Cards

- Access systems verify and validate accesses made by users to different resources according to some rules. Access systems can be implemented using IT infrastructure.
- A classical implementation refers to door access in large buildings.
- Such a system controls and validates the access in the rooms of a building (such as a company, an institution) according to some policies or access rights.
- This paper presents an access system for a building based on smart cards.
- Each door is commanded by an access point and all these are connected, through Internet, to a server which will take the decision.
- The access is requested through a smart card which memorizes the user's unique identity code.

Advantages:

- The design is based on the integration of AT89C52 microcontroller and commercially available wireless door bell.
- The overall cost of the system can be reduced if readily available low cost off-the-shelf components are used in developing the system.

Disadvantages:

- The design utilizes a low cost and readily available wireless door bell for wireless transmission of user information.
- These systems, though efficient, do not present a cost effective solution to the office automation problem.

III THEORY AND BACKGROUND

3.1 Modeling Human Behaviour

An intelligent door must understand the intentions of human beings in order to know if it should open or not. Understanding the intentions of humans is by no means a trivial task. Human behavior can be complex, and sometimes even irrational. A person walking towards a door can suddenly change to standing still, reading the newspaper in the stand beside the door. Perhaps the newspaper was the intended destination all along and not the door. Then again, the door could have been the initial target, but the front page of the newspaper made the person change his mind.

3.2 Computer Vision

There has been much research into the low-level processing of image data. As a result of this, there are several different ways of segmenting and extract features from various image sources. Computer vision is the science and technology of machines that see, where see in this case means that the machine is able to extract information from an image that is necessary to solve some task.

The detection and tracking of humans are easy tasks for humans, but is difficult for a computer for a variety of reasons. The human body can be morphed into many different poses, be clothed in a myriad of different clothes and carry accessories. All this comes in addition to the problem with the scenery, weather and lighting conditions in which to do the detection.

3.3 Segmentation

The main goal of the segmentation process is to divide an image into parts containing information of interest. To do this, several methods and algorithms may be used depending on the problem at hand. Taken what we know about the problem domain in the case of sliding doors, we see that we have some potentially very noisy data and difficult objects to track. This makes segmenting the image very hard to do in a consistent way.

3.4 Depth Mapping

Depth mapping is the use of lasers or other ranging equipment to get a 3D representation of the space in front of the sensor. Microsoft released an affordable solution for depth mapping with this sensor projects an infrared laser grid, and compares the resulting returned image with a base image to give a 3D representation of

what is in front of the sensor. This 3D representation is returned to the user in the form of a depth map ready for feature extraction

Step 1

Step 2

Figure 3.1: Example of a depth image. Lighter gray means closer to camera

3.5 Feature Extraction

The segmentation process reduces the raw image data into a more manageable amount of relevant data. The ratio of information to data is still too low, the input data must be transformed into a reduced representation set of features, a process called feature extraction.

IV COMPONENTS

4.1 PIR Sensors

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

PIRs are basically made of a pyroelectric sensor, which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels.

4.2 The PIR Sensor Itself

The IR sensor itself is housed in a hermetically sealed metal can to improve noise/temperature/humidity immunity. There is a window made of IR-transmissive material (typically coated silicon since that is very easy to come by) that protects the sensing element. Behind the window are the two balanced sensors

Transformer

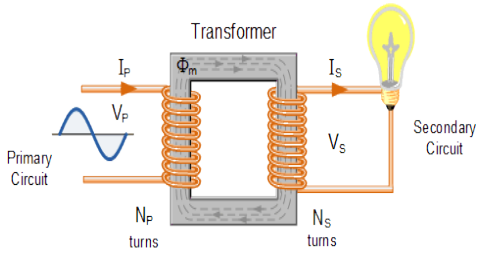


Figure 4.1: Transformer

A transformer can be defined as a static device which helps in the transformation of electric power in one circuit to electric power of the same frequency in another circuit. The voltage can be raised or lowered in a circuit, but with a proportional increase or decrease in the current ratings.

4.3 Microcontroller

Microcontroller is a small computer on a single IC that integrates all the features that are found in the microprocessor. In order to serve different applications, it has a high concentration of on chip facilities such as RAM, ROM, I/O ports, timers, serial port, clock circuit and interrupts. Microcontrollers are used in various automatically controlled devices such as remote controls, automobile engine control systems, medical devices, power tools, office machines, toys, and other embedded systems.

Figure 4.2: Microcontroller

4.4 Diodes

A diode is a device which only allows unidirectional flow of current if operated within a rated specified voltage level. A diode only blocks current in the reverse direction while the reverse voltage is within a limited range otherwise reverse barrier breaks and the voltage at which this breakdown occurs is called reverse breakdown voltage. The diode acts as a valve in the electrical and electronic circuit.

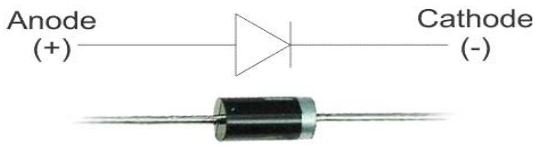


Figure 4.3: Symbol of Diode

4.6 CAPACITOR

A small device used to store huge amount of electric charge in a small room is called capacitor.

V ACCESSORIES OF SLIDING DOORS

5.1 Sliding Shower System

- Sliding Shower System
- Max Door size 750mm
- Max Height 2.5 mtrs.
- 8 mm Glass Thickness
- Standard ball bearing Rollers
- Track Length Max. 2 mtrs.
- Accessories in polished chrome finish
- Profiles in Anodised finish

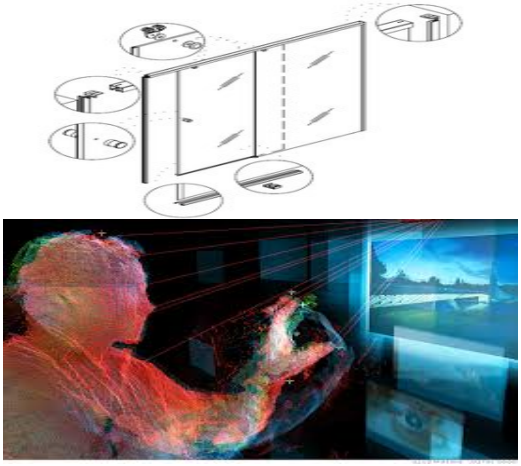


Figure 5.1: Sliding Shower System

5.2 Folding & Sliding

- Each Shutter weight Max. 40 kg
- Heavy duty track Satin finish
- Bottom Channel
- Flush bolt (Optional)
- Max 80 kg/System
- 30 34 mm Shutter Thickness S
- Standard duty bearing roller & clamp

Figure 5.2: Folding & Sliding

5.3 Domal Section Handle Guide

Riding on unfathomable volumes of industrial expertise, we are engaged in manufacturing and supplying an excellent assortment of Domal Handle Guide. Known as Sliding Door Accessories, Sliding Door

5.4 Concealed lock

With an aim to establish ourselves as the distinguished leader in the domain, we are committed to provide Concealed Lock. This concealed lock is manufactured at our end by using premium grade material and advance techniques keeping in mind the all set norms. The offered concealed lock is praised among customers for its superior quality. Offered concealed lock is well tested on numerous parameters by our quality experts before delivering to customer's end.

Figure 5.3: Concealed Lock

5.5 Star lock

We are instrumental in bringing forth the exclusive quality Star Lock. This star lock is available from us on several specifications as per the requirements of customers. Offered star lock is manufactured by using optimum quality material and ultra-modern techniques after following the all standard of industry. Our star lock is inspected on diverse quality parameters by our quality controllers before the final dispatch.

Figure 5.4: Star Lock

VI AUTOMATIC SLIDING DOOR REQUIREMENTS

The use of automatic sliding door mechanism can be very satisfactorily, there are still many people who do not know how such system works. If you are one of these people who keep on wondering about the wonderful operation of the automatic or electric sliding door mechanism

6.1 Door Requirements

The optical sensor

These electric sliding doors utilize motion or optical detection sensors in order to generate their motorized closing and opening functions. These sensors will be installed on the electric door or perhaps integrated into its framing from the side or above. The sensors utilize either microwave or infrared technology that enables the observation of movement and are typically used in industrial and commercial setting that allows easy access for everyone both able and handicap individuals, for safety and efficiency.

Rollers and tracks

Electric sliding door mechanism may be installed or hung in numerous ways relying on the style or the application of the door. Others can be hung from tracks above head and don't get contact with the ground plane but glide over it during the operation. They can also be installed on other side supported with tracks and rollers, which creates the connection from the floor plane

Motor mechanism

The motion or optical sensor is connected to an electric primary drive train which controls the clutch mechanism that is attached on the cog wheel or auxiliary drive and the panel or door panels. The door together with the auxiliary drive becomes connected because of the internal cables or belts, which are often made of rubber. They are the ones responsible for closing and opening operation of the door.

Figure 6.6: Access Control System

Aluminum sliding window roller

Window roller is high on demand in the industry for its durability & optimum quality. The offered window roller is precisely manufactured with the help of supreme quality material and cutting-edge techniques in compliance with set industrial norms. We provide these window roller different specifications as per the demand of customers

VII. WORKING PROCESS

7.1 Automatic Door

For the purposes of this discussion, an automatic door is a commercially available power operated or power assisted door used to facilitate public pedestrian traffic. Doors intended for other purposes, such as overhead garage doors, are not considered. Nor are automatic doors considered that are used for access to restricted areas, such as the operating area of a hospital or to private warehouse facilities.

There are, generally, three types of automatic pedestrian doors - sliding, swinging and revolving. Only the sliding type will be considered here. Other types exist but are very rarely seen.

Automatic Door Work

All automatic doors are equipped with a sensor that triggers opening of the door as a pedestrian approach. Prior to about 1972, this sensor was invariably a control mat that actuated the door by closing an electrical switch, or switches, embedded within the mat under the weight of the approaching individual. Since control mats respond to weight, they serve also to hold the door open as well as to initiate its opening.

Motion Sensor Work

Microwave motion sensors use the Doppler principle to detect motion. Microwaves reflected from objects within the microwave beam are received by the same antenna from which they are launched. If the reflecting object is moving directly toward the antenna, or if it has a component of motion toward the antenna, the wavelength of the reflected microwaves will be shorter than in the transmitted beam.

Process of Automatic doors

Automatic doors are one of the best modern inventions. All we have to do is walk up to the door and it magically opens for us. An automatic door is a closing or opening structure that is used to restrict access to an entrance through the use of automated technology. Doors can come in many types, such as swinging, rotating and sliding.

Remote controls

Some of the automatic doors require a human interface remote to control the opening and closing of the door. One example of such a door is garage doors. When the door receives the correct signal from the remote control, then it will open. The wave is usually at a specific frequency.

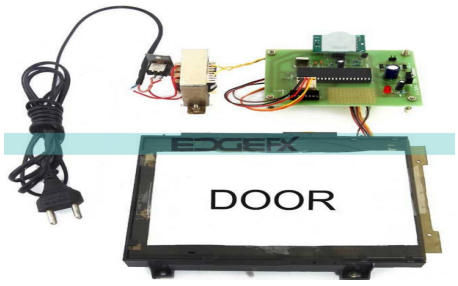
7.2 Automatic Garage Door Opening System

Opening and closing of doors have been always a boring job, especially in places where a person is always required to open the door for visitors such as hotels, shopping malls and theatres. Here is a solution to open and close the door i.e, movement sensed automatic door opening and closing system. This project is used to sense any body movement nearby the door. This is achieved with the help of a passive infrared sensor.

7.3 Automatic Door Opening System and Its Working

This automatic door opening system project is used to open and close the door automatically using PIR sensor. The hardware and software requirements of this project mainly include; 8051 series microcontroller, transformer, PIR sensor, motor with sliding door, motor driver IC, diodes, resistors, capacitors, crystal and transistor, keil compiler, language: embedded C Or assembly.

This proposed system uses a PIR sensor to sense the human body movement near to the door. Generally a human body emits infrared energy in the form of heat, which is detected by the PIR sensor from a particular distance.



VIII WORKING PRINCIPAL

8.1 Access Technology

Most people think that automatic door access is only for the entry-control devices, the most typical traditional door is installed in the keyboard controller or magnetic card reader, in order to obtain access to the right of access must swipe. Now, however, have more advanced access technologies and new applications market, now the technology used in access control systems: bar code, graphic ID, the magnetic bar code, Wiegand, inductive, smart code, biometrics, etc.

8.2 Directing Control Valves:

A direction control valve is used to change the direction of air flow as and when required by the system for reversing the machine tool devices. A direction control valve may be classified, according to the construction of the internal moving parts, as

1. Rotary spool Type.
2. Sliding Spool Type.

Solenoid operated valves

8.3 Solenoid Operated Valves:

Solenoid valves are electromechanical devices like relays and contractors. A solenoid valve is used to obtain mechanical movement in machinery by utilizing fluid or air pressure. The fluid or air pressure is applied to the cylinder piston through a valve operated by a cylindrical electrical coil. Solenoid valves are of two types,

- Single solenoid spring return operating valve,(5/2)
- Double solenoid operating valve.

IX RESEARCH RESULTS

9.1 Computer Vision

We have found the features we need to know about a person in front of the door. This presents us with a list of requirements for what the computer needs to be able to detect. This being in a real environment and operating on real-time data requires the sensor and computer to be able to handle the incoming data in real-time.

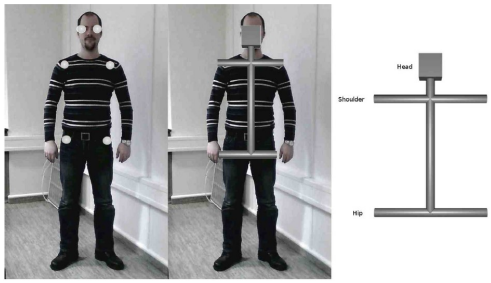


Figure 9.1: A Model of a Human Skeleton Simplified To Have Only the Features of Interest Namely Hip Angle, Shoulder Angle and Gaze Direction

Threshold and Edge Detection

These simple and quick algorithms as described in Section 2.2 are well suited for detecting changes in contrast in an image. This works well for statically lit environments, and can in those cases give good results. This however is not the case in situations where the edges between the foreground and background are not easily discernible, as they can be in real environments.

Image size	Segmentation	Average time
640x480	Sobel edge detection	1 ms
640x480	Canny edge detection	7 ms
640x480	Otsu threshold	2 ms
640x480	Image subtraction	1 ms
640x480	HOG detector	517 ms

Table 9.1: Segmentation Performance

CONCLUSIONS

This project has made an automatic sliding door more intelligent by better understanding human intentions. We have taken the raw data from a captured image stream and extracted the features of interest. In the context of the chosen decision mechanism, we have evaluated the feature extracted data to find the usable features. We have further adapted the output to make it fit into the framework of hidden markov models. A large set of data samples were gathered using manuscripts and fed into the learning algorithm of the HMM to generate the state and transition probabilities. Using the trained HMM, we ran all the manuscripts again, and evaluated the performance of the door using standard statistical tools.

FUTURE WORK

This project proves that it is possible to better understand human intentions using hidden markov models. In the previous discussion we looked at the relationship between traditional doors and the new intelligent door. From this we see that it could be interesting to change the view of when to open and not to preserve the true positives. By this we mean that the door should open unless there is a negative intention predicted instead of the other way around like it was made in this project.

It could prove beneficial to combine the findings in this project with the findings made by Solem (2010) to make a more robust reasoning mechanism. It could also be good to look into filtering and smoothing of the feature data to learn from the general motion instead of the small motions in between. There is news about a new Kinect sensor that is more sensitive and accurate that, when it arrives, could be useful in getting more accurate and less noisy feature data.

The findings in this project could be transferred to other areas like pedestrian movement and understanding. This could be very beneficial in the case of pedestrian crossings to better handle the lights in the crossing. This could possibly ease traffic congestion and make the crossings safer by being able to adapt to both the traffic and person trying to cross.

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