Robot Navigation Using Optical Odometry With Arm-Micro Controller

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Abstract

One of the most important issues for autonomous mobile Robots is their ability to navigate safely and reliably within their environments. Autonomous navigation can be defined as the ability of the robot to be able to answer these questions like finding current location, finding objects surrounded, finding the destination path. Some of the answers are found by introducing the Optical Mouse for Odometry. In the existing technology PIC Microcontrollers are used for navigation. The proposed technique introduced by the ARM-Microcontrollers which consummate Energy low , Quick navigation, Accurate Results and with respect to environment it is having less Noise.

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Keywords: Optical Odometry, PIC Microcontroller, ARM-Microcontroller, Robot Navigation

1. Introduction

Optical odometry is one in which the distance travelled is measured by optical means. Optical mouse consists of a single LED (Light Emitting Diode) **[2]** which it bounces the light off the surface. It also has a very small camera which takes pictures of the surface. It scans the surface 1500 times per second with the help of PIC Microcontroller later the digital signal processor receives the images that have been taken from the camera and analyses the differences from them. The image acquisition happened with help of sensors further they send signals to the PIC Microcontroller during this transmission of signals in image sensing**[7,8]**there will be loss of resolution, noise and artifact forming has been happened. PIC Microcontroller consists 16-bit of data acquisition at a instance. It is also causes a problem of Low bit rate of data transmission**[6,7]**.

Existing navigation techniques available in the literature are developed based on Lower-end Microcontrollers. Artifacts are developed due to these techniques .To reduce the blocking effect various post –processing methods **[7]** have been applied to get required image quality .This type of navigation techniques are not at all suitable for images where information is very essential. Here the proposed navigation technique which requires no need of pre-processing methods and retrieves the image with exact resolution, with accurate quality.

2. History

The first RICS microprocessor developed for commercial use In 1990, ARM Limited was established A market-leader for low-power and cost-sensitive embedded applications. The ARM is supported by a toolkit No processor is particularly useful without hardware and software development tools Instruction set emulator, assembler, C and C++ compilers, a linker and a symbolic debugger

3. Navigation of Robot with PIC Micro Controller

The idea of navigation of robot is not new. The discovery of robot navigation is achieved by many years back. The Navigation is happened with the help of Transmitter and Receiver. In this Three IR transmitters (IR LED) **[2]** and a receiver (Vishay TSOP1738) are mounted. IR LED is fed with 38 Khz carrier wave with the specification as described by the diagram below. Data transmitted from microcontroller is modulated using 555timer tuned to 38 Khz. The signal is transmitted to three IR LED's one after another using three transistors with their bases connected to the microcontroller. The circuit below is used for transmitting the signal one after the other, so that the obstacle map can be created.

Optical mouse act as a distance transducer, the input coordinates given to the Microcontroller are compared with the data received from the transducer and accordingly the duty cycle is varied so that the motion is along the path given as input.

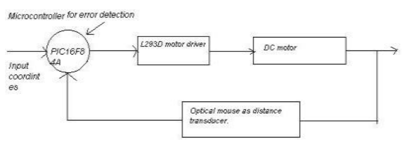


Figure 1. A closed loop feedback system used for making the motor move on a straight line.

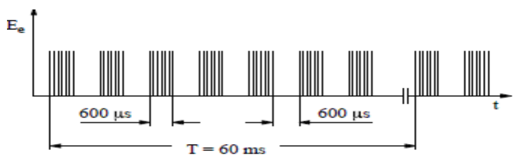


Fig 2. Typical signal that is transmitted by the IR LED

An obstacle map**[3,7]** is created from the data received by the TSOP**[3]**. Transmission signal consists of 7 bursts of IR signal, if more than 4 bursts are received by the TSOP then obstacle is present in the direction of the active transmitter. Thus activating the transmitters one after the other an obstacle map is created. From the obstacle map one can determine whether the obstacle is in-front of, to the left or to the right of the robot.

4. Interfacing of TSOP 1378 with PIC Microcontroller

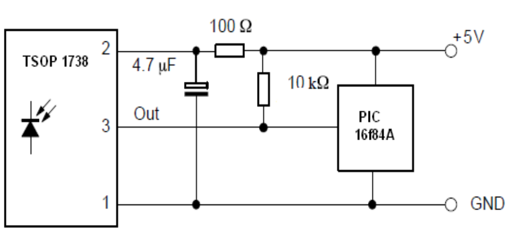


Fig 3 : Interfacing the TSOP 1738 receiver

The receiver also receives the commands sent by TV remote. Different destinations can be selected by pressing specific keys on the TV remote. Signal is decoded by the microcontroller using Sony format (SIRCS).Typical code is shown below

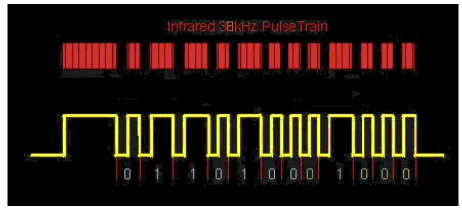


Fig 4: Infrared Data transmitted by a typical T V Remote.

The PS/2 mouse implements a bidirectional synchronous serial protocol**[5,6]**. The bus is "idle" when both lines are high (open-collector). This is the only state where the mouse is allowed begin transmitting data. The host has ultimate control over the bus and may inhibit communication at any time by pulling the Clock line low. The microcontroller is hereafter referred to, as the host in this section.

The device always generates the clock signal. If the host wants to send data, it must first inhibit communication from the device by pulling Clock low **[1]**. The host then pulls Data low and releases Clock. This is the "Request-to-Send" state and signals the device to start generating clock pulses.

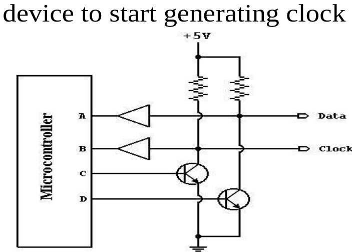


Figure 5: Optical mouse – interfacing circuitry

While transmitting the signals the following steps are necessary between host to ps/2.

- Bring the Clock line low for at least 100 microseconds.
- Bring the Data line low.
- Release the Clock line.
- Wait for the device to bring the Clock line low.
- Set/reset the Data line to send the first data bit Wait for the device
- to bring Clock high.
- Wait for the device to bring Clock low.
- Repeat steps 5-7 for the other seven data bits and the parity bit
- Release the Data line.
- Wait for the device to bring Data low.
- Wait for the device to bring Clock low.
- Wait for the device to release Data and Clock

In Host to Ps/2 data communication by the above steps following clock pulses are genera rated with respect to data.

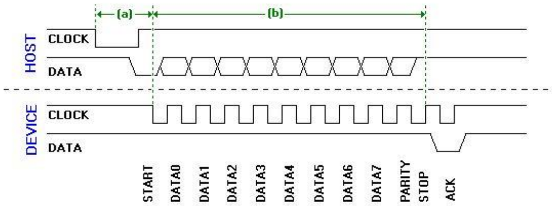


Figure 6: Detailed host-to-device communication.

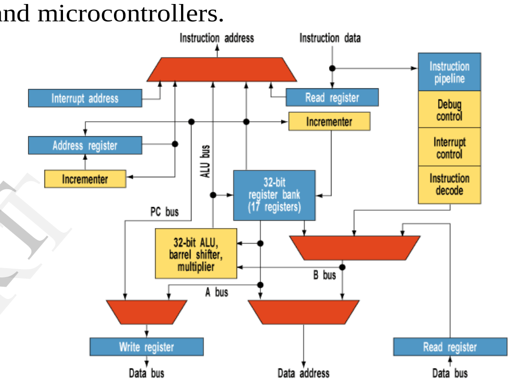
Robot navigation **[1,3]** is achieved using the obstacle map and the data from the mouse. Here mouse provides the precise distance traveled in x and y directions by the robot using which total displacement can be calculated.

Robot is given with destination coordinates Dx and Dy for navigation. Current robot co ordinates be Cx and Cy. Obstacle is set if any of the bit in obstacle map is set. A decision table is used to navigate is given below.

Condition	Current direction	Decision
Dx>Cx	Left	Forward
Dx<Cx	Right	Forward
Dy>Cy	Back	Left
Dy<Cy	Front	Left
Obstacle & Dx>Cx	Front	Right
Obstacle & Dx<Cx	Front	Left
Obstacle & Dy>Cy	Right	Front
Obstacle & Dy<Cy	Right	Back
Obstacle & Dx>Cx	Back	Right
Obstacle & Dx<Cx	Back	Left
Obstacle & Dy>Cy	Left	Front
Obstacle & Dy<Cy	Left	Back

6. ARM Microcontroller

The ARM is a 32-bit reduced instruction set computer (RISC)**[4]** instruction set architecture (ISA) developed by ARM Holdings. It was known as the Advanced RISC Machine, and before that as the Acorn RISC Machine. The ARM architecture is the most widely used 32-bit ISA in terms of numbers produced. They were originally conceived as a processor for desktop personal computers by Acorn Computers, a market now dominated by the x86 family used by IBM PC compatible and Apple Macintosh computers. The relative simplicity of ARM processors made them suitable for low power applications. This has made them dominant in the mobile and embedded electronics market as relatively low cost and small microprocessors **[5,6]** and microcontrollers.



7. Benefits of ARM Microcontroller over PIC controller

- There is an increase in the complexity of embedded products required by the market and consumer.
- The embedded developers are starting to be aware of the benefits of migrating to 32-bit microcontrollers. Not only do 32-bit microcontrollers provide over ten times the performance.
- Power consumption
- Smaller program size
- Faster software development time as well as better software reusability.
- Choosing an ARM based microcontroller is also a much better investment compared to other architectures

8. Initial Discoveries and Research Objectives

- To develop high quality exact replica of images
- To reduce the complexity
- Enhances Memory requirements to develop image
- To reduce the bandwidth requirement

9. Conclusion

In this paper a simple and strong method has been proposed for robot navigation using a optical device controller, In propose navigation method to reduce the noise, low quality resolution, ADC converter. the results are expected latter and accurate over PIC-Microcontroller.

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