Selecting the Most Effective ITS Application for Pedestrian Safety in Florida

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16. Abstract

Every year, nearly 70,000 pedestrians are injured and over 4,700 are killed in traffic crashes in the United States. The 2004 Florida Crash Facts report indicates that these numbers are 7,551 injured and 504 killed in Florida alone this past year. Recent developments in Intelligent Transportation Systems (ITS) show great promise in helping to reduce the number of injuries and fatalities on Florida's highway system. However, the Department of Transportation and other agencies must be careful to select the proper ITS devices that will be expected to have the greatest benefit.

The basic objective of this research effort will be to consolidate pertinent information on ITS applications related to pedestrian safety. The various applications are summarized and evaluated in terms of their effectiveness.

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Selecting the Most Effective ITS Application for Pedestrian Safety in Florida

INTRODUCTION

This report summarizes a research project conducted for the Florida Department of Transportation by the Center for Urban Transportation Research at the University of South Florida. The purpose of the research project was to identify those Intelligent Transportation Systems (ITS) applications that are applicable to pedestrians and determine which of these would be expected to prove most beneficial to pedestrians in Florida.

IDENTIFICATION OF PEDESTRIAN ITS TREATMENTS

The purpose of adding any ITS device to a pedestrian crossing is to try to make the crossing safer for the pedestrian and the motorist. Toward this end, five specific areas of ITS treatment have been identified[1]:

- Increased motorist awareness
- Feedback to the waiting pedestrian
- Feedback to the crossing pedestrian
- Pedestrian detection
- Visual impairment issues

These five areas will each be discussed below. Additionally, some of the common pedestrian treatments that correspond to them will be illustrated and evaluated for their applicability for use in Florida.

Increased Motorist Awareness

This focus area involves making the motorist more aware of the pedestrian conflicts that exist around them. Several enhancements that have recently been tried include improved signing, flashing beacons, and in-pavement lighting. Recently, many agencies have begun improving the visibility of their crosswalks by using fluorescent yellow-green pedestrian crossing warning and advance warning signing in the vicinity of pedestrian

crossings. While this does help to highlight the presence of a pedestrian crossing, the devices are passive, and thus only indicate that a crossing is there regardless of whether or not there is a pedestrian using the crossing. These static signs also have no intelligence, and thus cannot be included in the realm of ITS pedestrian treatments.

To be most effective, a device should have some type of detection of pedestrians such that motorists are notified only when there is a real potential for a conflict with a pedestrian. Otherwise, motorists will become complacent and not fully pay attention to the pedestrians that may be operating around them.

In-pavement lighting: One of the pedestrian ITS treatments that is getting a great deal of attention is the use of in-pavement lighting to draw attention to the pedestrian crossing. The Manual on Uniform Traffic Control Devices (MUTCD) allows for this treatment to be used only at uncontrolled crosswalk locations that are properly marked and have the appropriate permanent warning signs. The MUTCD specifically prohibits their use at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals[2]. The detection of pedestrians at these installations can be either active (pedestrian must push a button) or passive (pedestrian is detected without any overt action on their part).

In many locations where in-pavement lighting systems are in use, a passive detection system is used so that the system is activated whenever a pedestrian enters the crosswalk area. Studies performed in areas where these devices have been used generally show that they are helpful in alerting the motorist of the presence of pedestrians and the approach speeds of vehicles are reduced because of the in-pavement lighting[3]. Not surprisingly, the studies show that the primary benefits of in-pavement lighting at crosswalks occurs at night or in other lower visibility conditions like rain or fog.

Figure 1 below shows the in-pavement light installation in Orlando, Florida adjacent to the TD Waterhouse Center. The view is from the TD Waterhouse Center side of the road looking across the roadway crossing. The circles on the pavement that are on each side of the crosswalk are the in-pavement lights. The bollards on each side of the crosswalk house the passive detection system. When a pedestrian walks between the bollards, the

system is activated and the lights begin to flash for a predetermined period of time. Figure 2 shows the same location at night from the street view.

Figure 1 – Daytime view of in-pavement light installation

Figure 2 – View of in-pavement lighting at night

It is important to note that these systems should only be used on relatively narrow low-speed roadways. One of the primary concerns that the engineer must consider is that the approaching motorist must have adequate decision sight distance for the illuminated crosswalk. If the approaching traffic is traveling too fast, even once a driver perceived the crosswalk, they may not be able to safely come to a stop prior to entering the crosswalk. If the roadway crossing is too wide, it may expose the pedestrian to traffic for too great a period of time.

Feedback to Waiting Pedestrian

One of the other areas where ITS is being applied to improve the transportation experience for pedestrians is in the area of providing feedback to users. Often, when a pedestrian arrives at an intersection, they will push the pedestrian button several times while waiting for the WALK signal. This tendency helps to decrease the useful life of the button, and often leads to a malfunction of the button where it either fails to operate,

or it sticks. In some signal controllers, after several hours of constant detection, the controller will assume that the detector is malfunctioning and then ignore it. This could lead to a situation where inadequate time would be given to a pedestrian to safely cross the road. To combat this illuminated pushbuttons are being tried in some locations in order to provide some level of feedback to the waiting pedestrian. When the pedestrian pushes the button, a LED in the button lights up to indicate that the pedestrian call was received. Some buttons also feature a tactile click or audible confirmation tone.

Feedback to Crossing Pedestrian

Once a pedestrian has begun their crossing maneuver, it is helpful to continue to give them useful information to guide them safely across the street. In some cases, pedestrians need to be reminded that there may be vehicles turning across their path. Additionally, pedestrians seldom know how much time they have remaining to cross the roadway.

Animated Eyes: The animated eyes display is a signal indication that features eyes that oscillate between looking left and right in order to remind the pedestrian to look both ways before entering the crosswalk. Figure 3 shows an animated eyes display in use at an intersection in Clearwater[4].

Figure 3 – Animated eyes display

The animated eyes display may also be used to alert the motorist to the presence of pedestrians. In Figure 4 below, motorists exiting a parking garage are reminded to be aware of pedestrians that may be on the sidewalk just outside the garage. This was proven to be very effective in reminding motorists to yield to the pedestrians on the sidewalk[5].

Figure 4 – Animated eyes at the exit to a parking garage

Countdown signal: Probably one of the most useful pedestrian ITS treatment is the pedestrian countdown signal. This device displays to the crossing pedestrian the remaining time that they have to cross the street. Past studies have indicated that a very small proportion of pedestrians understand the meaning of the flashing hand display. Figure 5 shows a countdown display added as a retrofit to an existing pedestrian signal.

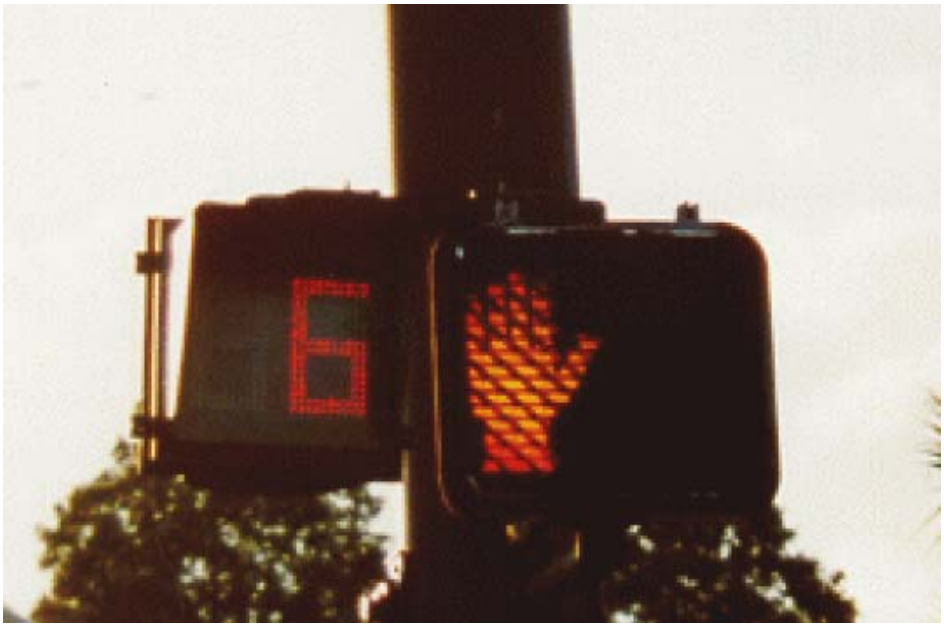

Figure 5 – Countdown display shown beside conventional pedestrian display

Figure 6 shows another countdown display that is integrated into the pedestrian indication. This type of display is becoming more common as countdown indications are increasing in popularity.

Figure 6 – Integrated pedestrian countdown signal

Studies on the countdown signal indications have typically shown a dramatic reduction in the number of pedestrians remaining in the crosswalk at the end of the flashing DON'T WALK. However, some studies do indicate that the presence of the countdown increases the number of people that will enter the crosswalk after the WALK period has expired. This is understandable and should be expected since the flashing DON'T WALK is typically timed for a relatively slow pedestrian walk speed. Pedestrians that walk faster, or those who may chose to jog or run across the intersection now have information that allows them to make a decision on whether they can make it or should wait. A previous study by the FDOT recommended that "countdown signals are not recommended for use at standard intersections in Florida[6]." However, many of the local maintaining agencies are currently implementing countdown signals at any intersection that is being rebuilt or refurbished. The maintaining agencies indicate that the pedestrians desire the countdown displays and readily understand them.

Pedestrian Detection

Passive detection (microwave and infrared): An area that has started to see more emphasis in recent years is in passive detection of pedestrians. Passive detection means that the pedestrian is detected without them having to push a button or stand on a particular pressure-sensitive part of the sidewalk to be detected. Most of the current passive detectors either utilize microwave or infrared systems to detect pedestrians. One of the most significant obstacles to greater deployment of passive detection is that the

detectors typically cannot discern which crosswalk the pedestrians desire to cross, so typically, they place a call for all pedestrian phase. Another potential weakness of the passive systems is their susceptibility to false calls[7]. Under some conditions, vehicles that turn right at the intersection might erroneously trigger the pedestrian detector. This results in greater frustration and decreased efficiency for motorists at the intersection due to calling pedestrian phases that may not be needed. Some studies have been performed for video detection of pedestrians; however the expense and concerns over false calls and missed calls due to glare and other lighting issues demonstrate that this technology is not yet mature enough for consideration.

Visual Impairment Issues

Several issues arise when we attempt to accommodate users who are not able to see the pedestrian indications, or find the pedestrian push buttons that we place at an intersection. To assist these users, we must rely on either auditory or tactile feedback to relay a message to them regarding the status of the traffic signal.

Auditory: Audible pedestrian indications are beginning to see more use now as more agencies try to accommodate users with special needs. In most of these systems, a click or locator tone is emitted to help the sight-impaired pedestrian locate the pedestrian button. Once the pedestrian button is activated, some systems will switch to a different type of tone or sound to verify that the call has been received. Once the walk indication is given, a different sound will be emitted to indicate the start of the WALK interval. In some cases, these are given as various bird chirping sounds, while some systems use verbal spoken text. A different tone, chirp, or message is then utilized to indicate the flashing don't walk interval.

When installing audible pedestrian indications, it is critical that the agency carefully monitor the installation. In many cases, blind people will listen to the sound of traffic moving in adjacent travel lanes to determine when they should cross. This is being complicated by increased use of both motorcycles (very loud, drowning out other vehicles) and hybrid vehicles (very quiet and barely discernable). Additionally, if the

volume of the audible pedestrian indication is too loud, then the blind pedestrian may also not be able to hear the other audible clues that they typically use to cross the intersection over the sound of the chirp. However, many audible pedestrian indicators are equipped with automatic gain control which adjusts the volume based on the background ambient noise level.

Tactile feedback: Tactile pedestrian buttons help a sight-impaired pedestrian find the information that they need to safely cross the street. In addition to providing information about where the button is to cross which street, some accessible arrows provide a vibratory indication when the WALK signal is on and possibly other information in Braille.

Figure 7 shows an accessible pedestrian signal that includes both auditory and tactile features. Tactile features on the signal include a Braille map of the intersection and raised features to help a sight-impaired pedestrian find the correct button and the crosswalk. The arrow on top indicates the direction of the crossing, and this arrow vibrates when the walk indication is on. The pedestal also includes a speaker for providing auditory feedback as well. This model is capable of a variety of tones or speech feedback.

Figure 7 – Accessible pedestrian signal

CURRENT USE OF PEDESTRIAN ITS APPLICATIONS IN FLORIDA

Early in this research project, a survey was conducted of maintaining agencies within Florida to attempt to assess what ITS pedestrian features are currently being used in Florida. The results of that survey, in conjunction with follow-up discussions and knowledge from traveling throughout Florida are summarized below:

Countdown signals: Several agencies were deploying pedestrian countdown displays. At the time of the survey, the FDOT had no vendors approved on the Approved Products List (APL). Unless a traffic control device is on the APL, agencies are not supposed to use it on any road the public is invited to travel on in Florida. Now that vendors are on the APL, several maintaining agencies are installing countdown displays. The countdown signals are typically very popular with the citizens, and the local agencies feel a significant need to install this treatment at locations with moderate to heavy pedestrian use.

In-Pavement warning lights: Several agencies have installed in-pavement warning lights in very heavily-used pedestrian crosswalks. Studies have indicated that the in-pavement lighting systems increase the conspicuity of the pedestrian crossing and help to reduce the speed of the oncoming vehicular traffic. Both of these results are very favorable for increased usage of this ITS treatment. However, as indicated previously, this application is not suited to be used on high-speed, high-volume roadways.

Animated eyes: The animated eyes displays have been used at just a few locations in Pinellas County and Miami-Dade County. The animated eyes display has been shown to be effective in reducing the conflicts between vehicles and motorists. This treatment is particularly recommended where conflicts between turning vehicles and pedestrians are significant.

Accessible pedestrian indications: Most agencies will install audible pedestrian indications to serve sight-impaired pedestrians when there is an identified need. Many agencies are reluctant to do this as a blanket policy due to noise complaints from residents near the intersection, who occasionally hear the audible devices going off throughout the night. However, many agencies do have a procedure where a specific request for audible pedestrian treatments can be evaluated and installed if justified. Unfortunately, there are several different types of audible pedestrian devices in use in Florida. In different areas of the state, different tones are typically used. It is recommended that the Department continue to work with the local agencies for the blind

to utilize whatever types of audible tones are preferred locally, or whatever is being taught to sight-impaired users in their accessibility training programs.

CONCLUSIONS

The Department of Transportation should continue to support the inclusion of pedestrian ITS features at locations throughout the state. However, the ITS features needed at each location should be individually identified and suited to solve a need at that location.

Countdown signals have proven to be popular with pedestrian users. However, the additional capital and maintenance costs should make this treatment something that is used just where pedestrian volumes would justify the added expense. Additionally, countdown signals should not be used at intersections where railroad, bridge, or emergency vehicle preemption might result in an erroneous display on the countdown indicator.

In-pavement crosswalk lights should continue to be deployed where needed for high pedestrian volumes. But as mentioned above, these devices should not be used at locations with high approach speeds or with large crossing widths. These must be utilized only at uncontrolled intersections as prescribed in the MUTCD.

As indicated above, the Department should continue to work with the local agencies for the blind to support the inclusion of accessible pedestrian features where needed. The costs to include all of the accessibility features at every intersection would be prohibitive, so it is certainly in the interest of both the sight-impaired pedestrians and the Department to concentrate on doing the needed intersections only, but doing them right.

Other features such as buttons with LED indicators are not yet widely used in Florida due to the added expense and the fact that few vendors are currently on the APL. It is recommended that FDOT continue to evaluate these devices and continue to add them to the APL as appropriate.

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