1-Emerging Technologies for Pedestrian Crosswalks

-Technology is a rapidly evolving field, just look at the computer industry. When we say next generation technology we now think in terms on months, not years. There are few aspects of modern American society which have not been profoundly affected over the past ten years by the growth of low-cost computing power, ubiquitous wireless communications, and the advent of the Internet. We have very rapidly gotten used to shopping for books, music, and clothing online and to doing our banking, our stock trades, our bill paying, our correspondence, our budgets, our home photograph albums, and our schoolwork on the computers which are now present in the majority of U.S. homes and almost every business

-Last ten years, the ITS program has provided many opportunities to use the same technologies in a number of transportation areas. Most of this has primarily focused on motor vehicle safety and mobility (i.e. Ford OnStar, TMC's). However, recent developments in hardware and other technologies offer the potential of improving pedestrian safety and access by addressing specific problems associated with crossing the street.

-State that copies of your presentation have been handed out or available in back of room.

2-Pedestrian Fatality Rates

-Let's start with a little safety quiz: in 2000 how many pedestrians were killed in the U.S.? Of the 41,821 total killed in crashes, 4739 or 11% of the total number of traffic-related fatalities are pedestrian. The good news is that this number has declined by 10% over the last ten years and is down from 6,482 in 1990 to current figure.

- In 2000 NYS had 335 ped fatalities (25% of NY total) & 17,230 ped injuries (8.9% of NY totals); 38 bike fatalities (2.8% of NY totals) & 7061 bike injuries (3.7% of NY totals).

-The map shows the pedestrian fatality rates (per 100,000 pop.) for NE states. It is not surprising that the highest rates occur in the more urbanized states.

-Looking at some of the statistics, most pedestrian fatalities occurred in urban areas(71%), at non-intersection locations(78%), in normal weather

conditions(91%), and at night(64%). There were 79,000 pedestrians injured in traffic crashes.

3-Untitled

-**On the whole perhaps your state is doing well compared to the national average. And compared with many of the other crash-related fatalities (11%) may not seem like a lot.**

-**However pedestrian fatalities and injuries become major "community" problems and will typically make local news. Every community it seems has problem location or intersection; near school crossings, churches, shopping centers, nursing homes and LOTS of inattentive, aggressive drivers.**

-**As with motor vehicle operators or bicycle riders, the behavior and awareness of the pedestrian is a very important factor in safety. However, we can aid this behavior with education, enforcement and engineering. Engineering through technology is a means of enhancing the potential for pedestrian safety.**

4-Objective

-**Obviously there is a lot we can do to improve pedestrian safety through education and enforcement, the two most important areas. Technologies offer additional opportunities to improve pedestrian safety at problem locations. The objective of my presentation is to present information on advanced technologies used to enhance pedestrian safety. For each I'll talk about the benefits and possible cost savings.**

-**My second objective is to show you real world situations where this technologies are being applied**

-**Using advanced technologies is NOT for every location. Technology brings with it additional issues and concerns such as: increase maintenance cost, training of personnel to repair and calibrate equipment, possible liability if the system fails, etc.**

5-Problems: Technologies:

There are a number of problems pedestrians experience as they are crossing a street:

Lack of motorist awareness of crosswalk area **- Traditional pavement markings used for crosswalks are obvious to pedestrians, but can be difficult to detect by approaching motorists.** ***Feedback to the Waiting Pedestrian*** **Requiring pedestrians to push a button for the WALK signal is intended to increase the time allotted to cross the street. Many pedestrians are unaware of this concept or believe the button does not work.** ***Detection of pedestrian in crosswalk*** **Detecting pedestrians has traditionally relied on push buttons. Unfortunately, the lack of feedback to pedestrians and poor installation and maintenance practices often leads to nonuse. Some longer distance street crossings are also difficult for elderly and younger children (MUTCD – 4 feet per second).** ***Feedback to the Crossing Pedestrian-*** **Pedestrians crossing the street are sometimes unaware that vehicles may be turning across their path during the WALK signal, which can result in a serious conflict. (left turns on green/right turn on red). Crossing pedestrians may also lack an understanding of the flashing DON'T WALK phase of the signal, which can produce unsafe crossing behaviors.** ***Visual Impairment Issues*** **- Visually impaired pedestrians may have difficulty with a number of tasks associated with crossing the street, from simply locating the crosswalk to understanding the type of traffic.**

I would like to talk about the following five areas of technologies that are presently being used to address these problems.

6-In-Pavement Lighting

-*In-Pavement Lighting*- In-pavement lights are being used at crosswalks to alert motorists to the presence of a pedestrian crossing or preparing to cross the street.

Any questions on how it works?…

7- In-Pavement Lighting – Howard County, MD

Two years ago two children were injured while crossing Mayfield road in Howard County, MD. The side street to the school forms a T-intersection with Mayfield Road. This mid-block crossing occurs on a street that posted at 30 mph. A traffic signal probably could have been installed at a cost of $100,000, however the county wanted to try something cheaper and not greatly impact mobility of motorist.

-**A 1997 installation on Orlando, FL demonstrated small positive effects on reducing vehicle speeds, increasing vehicle yielding to pedestrians, and reducing pedestrian/motor vehicle conflicts**

Some recommendations: 1) main st. approach speeds should be 45 mph or less; 2.) main st. traffic volumes should be 5,000 to 30,000; 3) should be visible at 400 ft for <35 mph and at least 600 ft for >40 mph; 4) a minimum of 100 pedestrians per day is suggested.

8- In Pavement Untitled

-When the pedestrian activates the system, either by using a push-button or through detection from an automated device, the lights begin to flash at a constant rate, warning the motorist that a pedestrian is in the vicinity of the crosswalk ahead.

-The amber lights are embedded in the pavement on both sides of the crosswalk and oriented to face oncoming traffic.

-The flashing lights are only activated when a pedestrian wants to cross and are automatically shut off after a set time period.

9- In Pavement Untitled

-The design is similar to RPM in that the LED is protected by a snowplow resistant casting design. The casting are about 8-10 inches in diameter and protrude less than _ inch above the pavement.

-The amber lights are visable during the daylight as well as at night

-Several manufactorers – shown here is traffic signal corp.

-Technology continues to improve and get cheaper.

10- In Pavement Untitled

Should also mention the county installed median islands as traffic calming devices about 1/2mi on either side of the approached to slow traffic down.

11- In-Pavement Lighting

-Typically cost are $15-$40,000 installed per crossing, cost range depends on width of road and whether automatic detection is used. This is about 1/3 cost of traffic signals.

-**Studies have shown a substantial benefit. California was the first to test in 94. They install at six locations throughout the state over a 6 month period. The data indicated that** the percentage of drivers yielding to pedestrians in crosswalks increases 158% during daylight hours and an encouraging 840% during nighttime hours. California adopted the in-pavement lighting to their standards in 97.

-This technology is being applied at marked school crosswalks (Howard county), marked mid-block crosswalks, marked crosswalks on uncontrolled approaches.

-Several States/communities now are using this and have established guidelines for it's use – primarily based on ADT, pedestrian volume, and speed.

- A new chapter in the MUTCD has been added (chapter 4L – in-roadway lights) has been added to set standards the application of this technology.

12-Illuminated Pushbutton

-At many intersections pedestrians must push buttons to activate the WALK phase. However they often do not know whether the button has been pressed and whether its functional.

-If the WALK phase does not appear soon after the button is pressed, they may believe that the button does not work and start crossing early.

-*Illuminated Pushbutton*-This low-tech device is very similar to an elevator button in that it lights up when pushed and provides instantaneous feedback to the pedestrian that the button is working and that the signal will change.

13- Illuminated Pushbutton

-There are various designs and costs by different manufacturers

-A study in Canada showed that there is very little difference in pedestrian usage for push buttons without or with the illuminated light. In other words the effects of illuminated push buttons on changing behavior may be limited – it does not address several basic reasons for pedestrians not using push buttons.

-It did greatly reduce the number of complaints that the conventional push buttons were not working. So it may be worth the investment simply to cut down on costs associated with field checking button.

-The suggestion is to use this at locations where there are significant numbers of pedestrians crossing

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14- Pedestrian Signal Head - Count-Down Signal

-One of the most frequent complaints received by traffic engineers is that a pedestrian signal head is either malfunctioning or improperly timed. Usually the signals are found to be operating as intended, and the ultimate cause is pedestrian confusion about the operation and meaning of the pedestrian signals. In an effort to "convey a clear, simple meaning" several new pedestrian signal head design are being evaluated.

-*Count-Down Signal*- Count-down signals are used in conjunction with conventional pedestrian signals to provide information to the pedestrian regarding the amount of time remaining to safely cross the street. It is hypothesized that pedestrians will use this information to make better decisions about when to enter the crosswalk. While earlier installations allowed for the count-down timer to start either when the WALK indication appears or when the flashing DONT WALK indication appears, recent research has shown that the countdown display should only be displayed during the flashing DON'T WALK phase. The timer continues counting down through the flashing DON'T WALK (Hand) clearance interval. When the steady DONT WALK or Hand appears, the countdown signal will be at zero.

15- Ped Signal Head- Cambridge, MA

Signal Heads installed by City of Cambridge at intersections where large numbers of people cross and at places where there is a high number of elderly pedestrians. Experimentation approved to date on this have required that the countdown indication must only be displayed during the flashing "Don't Walk" portion of

the pedestrian phase.

16- Pedestrian Signal Head -Count-Down

Signal

-The cost of these devised are not that much more than a typical LED pedestrian signal head.

Evaluations are being done for the count-down system in Minnesota. Mn/DOT and representatives from city and county agencies selected 6 sites for the pedestrian countdown system study. The research revealed that the pedestrian count-down indicators, used in conjunction with the international symbols, increased the the percent of successful crossing from 67% to 75%. The count-down indicators made the biggest impact among the elderly (57% to 68%) and among teens (58% to 73%). Mn/DOT is developing guidelines for appropriate intersections. Not every intersection is a good candidate – the guidelines will assist engineers in determining the locations that best meet pedestrian needs.

-17-Pedestrian Signal Head -Animated Eyes Display

Animated Eyes Display- This device is intended for use at pedestrian crosswalks as an alternative to conventional pedestrian signals and are expected to encourage pedestrians to look for turning vehicles traveling on an intersecting path by including a prompt as part of the pedestrian signal. The prompt is a pair of animated eyes that scan from side to side at the start of the WALK indication.

The animated eyes have been used and evaluated in Clearwater & St. Petersburg, FL.

- # of conflicts decreased in the range of 59-94 %.

-Low vision pedestrians were able to identify WALK signal at a distance 57% farther away.

Recommendations

- Use of animated eyes be added as optional to MUTCD

-Use eyes during entire WALK interval; not during DON'T WALK interval

-Use eyes white in color instead of blue.

18- Pedestrian Signal Head - Animated Eyes Display

The cost of these devised are not that much more than a typical LED pedestrian signal head.

19- Leading Pedestrian Interval

1993 Study by Michael King for NYCDOT at 26 locations with LPIs with data from 5 years before and 5 years after. There were also several nearby control sites at similar intersections. Data showed significant reduction in vehicle/ pedestrian crashes in the before and after conditions and with the controlled sites.

In 1997, three intersection installations with a 3 second LPI were studied in St. Petersburg, FL by R. Van Houten for Insurance Institute for Highway Safety. Found conflicts to become non-existent. The odds of a conflict for a pedestrian leaving the curb during the beginning of the WALK were reduced by 95%. The odds of a pedestrian yielding to a turning vehicle decreased by about 60%.

-The system works best under certain conditions; where there is long pedestrian crossing distances, crossing near schools or senior centers, or intersections with high pedestrian traffic. Several other locations have also installed the countdown device.

-Chapter 4E in the MUTCD addresses design and operation of pedestrian signal head. The countdown and moving eyes are still experimental.

-The animated eyes are being evaluated in Clearwater, FL.

20 – Automated Detectors

-I mentioned earlier the weakest link in the pedestrian push-button system is the pedestrian. Automated detection technology can be applied to pedestrian crosswalks.

-These systems can be used to augment the traditional push button technology to alert signals of the presence of a pedestrian waiting to cross intersections. In addition they can be used to detect the presence of pedestrians remaining in crosswalks during signal phase changes.

-The systems can be used to reduce vehicle and pedestrian conflicts by adapting WALK/DON'T WALK signals. They are similar to priority signal control in which phase splits are adjusted to permit slower moving persons to safely cross the intersections.

-The systems can use a variety of detection technologies including infrared or microwave based.

-***Microwave and Infrared Detectors -*** Both of these devices provide the means to automatically detect the presence of pedestrians in the targeted curbside area. The microwave detector may also be used to detect pedestrians while moving in a designated crosswalk area. When used at the curbside area, they may either replace or augment the standard push button used to activate the pedestrian call feature. When used to detect pedestrians in the crosswalk, the function is to detect the presence of individuals requiring additional time to cross and, accordingly, extend the clearance interval and provide more time to cross.

21- Automated Detectors Rochester, NY

Automatic detectors were used here to supplement the push button at State and Corinthian Sts, intersection in town down area. State street is a major N-S arterial and Corinthian is a very short E-W street that forms a T-intersection with State. The only time the traffic signal changes on State street is vehicle presence on Corinthian or pedestrians via push button. Because of the lack of use of peds using the push button, and heavy ped traffic (parking garage on Corinthian) an automatic detector was used to detect ped presence at the crosswalk to either initiate the pedestrian phase at pedestrian signals or cancel if the ped leaves the curb.

Biggest disadvantage is the false alarms – but newer generations of this technology are getting better.

22- Automated Detectors

Three sites in the United States were used to compare reductions in vehicle and pedestrian conflicts at intersections between push-button only, push-button with automated detection, and automated detection only. The three sites were Los Angeles, Rochester NY, and Phoenix. Using automated detection only, at the Los Angeles site and with the push-button taped over, resulted in an increase of 7% to 17% of conflicts (probably due to pedestrians not realizing detection had been automatically made). In general, there was an 81% decrease in the number of pedestrians crossing during a DON'T WALK with the addition of Automated detection to intersection with operational push buttons. Conflicts encountered by pedestrians during the first half of the crossing were reduced 89% while conflicts for the second half were reduced 42%. Conflicts associated with right turning vehicle were reduced 40%. All other conflicts were reduced 76%. Most of these reductions are attributed to reliable detection and signal extension for pedestrians in the process of crossing, not those waiting at the curb to cross.

23- Accessible Signals

The primary technique that pedestrians who have visual disabilities use to cross streets at signalized intersections is to initiate their crossing when they hear the traffic in front of them stop and the traffic alongside them begin to move, corresponding to the onset of the green interval. This technique is effective at the vast majority of signalized intersections. The existing environment is often sufficient to provide the information that pedestrians who have visual disabilities need to operate safely at a signalized intersection. However there are locations where accessible signals are required. Accessible pedestrian signals are products that supplement the visual signals and cues used by sighted pedestrians and enable visually impaired pedestrians to safely and independently negotiate intersections.

Categories of accessible signals include signal-mounted speakers, transmitter/receiver systems, and push-button systems. ***Signal-Mounted Speakers*** - These devices have traditionally been referred to as audible pedestrian signals and are specifically designed to help visually impaired pedestrians by emitting a buzzing, whistling, beeping, or chirping sound that is correlated with the visual WALK/DONT WALK signal. The two most popular audible pedestrian signals used in the US emit either a buzzer or a birdcall sound. The audible signal most frequently used in the western US emits a "peep peep" tone for the east-west direction and a "cuckoo" tone for the north-south crossings. Audible signals indicate only that the WALK indication is displayed, not that the intersection is clear. The devices are meant to complement rather than be a substitute for a visually impaired persons' orientation and mobility skills.

Transmitter/Receiver Systems-These systems use infrared or LED transmitters located at the ped-head to transmit a speech message to hand-held receivers. "Talking Signs" is a product of this type. Messages may identify the location and direction of travel of the pedestrian, give the name of the street to be crossed, and provide real time information about WALK and DON'T WALK intervals. It is an infrared wireless communications system that is designed to work in both interior and exterior applications and makes confident independent travel possible for visually impaired individuals.

Push-Button Systems- Accessible push-button systems include vibratory and/or audible signals

and range in complexity. The very simple system includes a tactile (raised) arrow to indicate the direction of the crossing associated with the button. The more complex systems include a series of tactile messages about the street crossing, locator tones to aid pedestrians in finding the push button, and audible signals to indicate when the signal has changed.

24- Accessible Signals, Burlington, VT

Church Street Marketplace in Burlington, Vermont, draws pedestrians to the city's downtown area in all seasons of the year. **Burlington, Vermont** completed its four-block-long Church Street Market-place in 1981, and the pedestrian mall remains a

popular destination for residents and tourists alike. The mixture of shops, restaurants, vendor carts, and offices serves as a draw for pedestrians in all seasons of the year. Accessible signals are used at crossing at both ends of the pedestrian walkway to alert blind pedestrians of changed conditions.

25- Accessible Signals

Once a particular signalized intersection is reviewed for pedestrian safety in general, then an examination should ensue that considers whether accessible pedestrian signals are necessary to provide information that is not readily apparent in the existing environment.

The factors that might make crossing at an intersection difficult for pedestrians who have visual disabilities include: increasingly quiet cars, right turn on red (which masks the beginning of the through phase), continuous right-turn movements, complex signal operations, traffic circles, and wide streets. Further, low traffic volumes might make it difficult for pedestrians who have visual disabilities to discern signal phase changes.

Under the ADA, accessible pedestrian signal information is required at newly signalized intersections that have actuated pedestrian signals and at intersections that lack the cues needed by people with visual disabilities and that are undergoing signal upgrades.

26- Real World Examples

27- Additional FHWA Resources