Intelligent and self control safety traffic light system for road constructions

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Abstract: - The Intelligent Traffic Light is one of the best devices in work zone traffic flow control systems. This device can replace one or both flaggers during the lane closures on the event of a road construction. The portable traffic light can be best utilized in traffic flow control for long term or short term lane closures on construction sites, to control two-way traffic in a single lane. By implementing new technologies in automating traffic flow in road construction site could possibly eliminate the usage of a conventional flagman. The intelligent traffic light system is designed to solve problems which contribute towards hazards at road construction site and to be inline with the road safety regulation which is taken into granted by the contractors. The automated portable traffic light system can reduce costs and increase safety for the road users by eliminating the need for a human flagmen. This system is applicable for public and privately funded road construction projects that require overnight or 24-hour traffic control as well as in different weather conditions.

Key-Words: - Intelligent traffic light, programmable logic controller, flagman, smart control application

1 The intelligent and safety traffic light system for roads construction site

The intelligent construction safety traffic light system is designed to be an intelligent system for smooth traffic operation in a typical road construction site with high frequency of vehicles. The automated system which operates without human intervention at all time regardless of weather conditions enables the system to work efficiently for long working durations. The system has many features which empowers the users on dangers at a road construction site. The automatic vehicle presence detection and control system enables the road users to be informed on the traffic flow ahead.

Traffic flow control in a road construction site is difficult to be monitored and controlled in both directions especially during rainy seasons. The intelligent construction safety traffic light system can be best placed at high traffic frequency locations for effective, safe and in ensuring smoothness in the traffic flow in a dangerous road construction site.

The most important factor in a road construction site is the hazard warning sign for the road users. If a system is capable to indicate the road users without human intervention and regardless of weather, it will help the contractors
and their workers doing their work without worries.

Fig. 1 shows one of the road construction sites which are typical dangerous for all the road users.

Fig. 1: A road construction site

The intelligent construction safety traffic light system consists of a number of components working together to perform simple repetitive task [1]. The basic system requires motion detection sensors to detect the presence of vehicles on road construction site, a control unit to process the information and to establish communication between the master and slave unit [1].

The basic structure of the intelligent construction safety traffic light system is shown in Fig. 2.

Fig. 2: Structure of the intelligent construction traffic light system

2 Usefulness of the Intelligent Construction Safety Traffic Light System

The intelligent construction safety traffic light system is designed based on environmental factors on the road construction site and limitations of a flagman. The device could be one of the best practice in road construction traffic control systems.

The designed device is to replace th conventional flagman who is required during the lane closures on a certain construction zone. Since the designed device is a portable traffic light and best to be utilized in temporary traffic flow control for long term or short term lane closures on construction sites. The device is suitable to control two-way traffic flow in a single lane [2] road construction sites.

The device can be used in publicly and privately-funded road construction projects which require overnight or 24-hour traffic flow control operations regardless of weather condition. The device is also cost efficient and less compare to the invested cost in the long run.

Some of the main factors which contribute towards the down fall of a flagman compare to the intelligent construction safety traffic light system is shown in Table 1 [2].

Table 1. Comparison between flagman and the intelligent construction safety traffic light system

<table>
<thead>
<tr>
<th>Factors</th>
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<th>Intelligent construction traffic light system</th>
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<tbody>
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<td>Working hours</td>
<td>limited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Weather condition</td>
<td>not reliable</td>
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The intelligent construction safety traffic light system can be best utilized by road construction site contractors and for any temporary traffic flow control. The system can replace the use of humans in any kind of traffic flow control operation [2].

3 Control components Intelligent Construction Safety Traffic Light System

The intelligent construction safety traffic light system has a number of individual components working together to perform as it is designed. As the construction safety traffic light system is an automated device, the system requires sensors to communicate with the control unit for relevant control functions.

Apart from the sensors, the communication medium for the construction safety traffic light system is using Radio Frequency (RF) as the means for low cost and efficient wireless communication between the master and slave unit. The intelligent construction safety traffic light system is capable to perform the entire process without human intervention.

The intelligent construction safety traffic light system consists of two main components which is connected one another wirelessly via RF. The master control unit can be placed in a distance away from the slave unit in a certain road construction site.

3.1 Sensor unit

There are two types of sensors used to enable the intelligent construction safety light system to operate without human intervention at all time. The system uses infra red detection and motion detection system at both units of the traffic light unit. Both traffic light units is connected via wireless. The wireless unit is designed to be located in each traffic light unit which is capable to communicate within 100 meters in radius.

The motion detection sensors will be used to detect the presence of vehicle at one or both end of the construction site. The detection is approximately 6 meters from the traffic light unit. The detection signal will be used to indicate to the control unit on which end of the construction site has high priority for the users.

Vehicles passing each traffic light unit will be counted using an infra red sensor. The total number of cars passing each traffic light unit will be temporary saved in the control unit and being compared with the another end to make sure all the vehicles are out before the transition of the traffic light changed.

3.2 Programmable logic controller

A programmable logic controller (PLC) is used in the intelligent construction safety traffic light system as shown in Fig. 2. The PLC is an intelligence device which is capable to work without human interventions at all times regardless of duration and weather conditions [3].

The PLC will be placed in the master unit for all the control operations. The wireless circuit is used to generate inputs to the PLC as changes are detected in the sensors. As programmed the PLC will trigger the light indicators at each end of the construction site via wireless. The number of traffic light is integrated based on the number of junction on the road construction site. The system only requires one master controller and others can act as the slave unit for the entire operation.

4 Usefulness of an intelligent construction safety traffic light system

The intelligent construction safety traffic light system is designed for the factors effecting at the road construction site and limitations of a flagman. The system could be one of the best practices in road construction traffic control systems. The flagman is to be replaced by the intelligent construction safety traffic light system during the lane closures on a certain construction zone [4].

The system is designed to be a portable traffic light and best to be utilized in temporary traffic control for long term or short term lane closures on construction sites, it is suitable to control two-way traffic in a single lane [2].

Fig. 3 shows the conventional system utilizing a flagman during a lane closure to control the traffic flow.
There are many other means of ways to control and to maintain the efficiency of the traffic flow in a certain road construction site. Apart from the conventional practice, automated flagman is now a popular device in ensuring road users safety [5 - 7]. The automated flagman is shown in Fig. 4 is one of the common flaggers used at most road construction sites as a warning indicators to the road users.

The automated flagman is very common now days in most of the road construction site since they are easy to handle and be able to operate for long hours regardless of weather conditions. Apart from that they are efficient in operation since there are no human factors involved in the indication process [5 -7].

The intelligent construction traffic light system is empowered by all the factors towards the downfall of the existing system and method used in ensuring the smoothness of traffic flow in a certain road construction site. The system can be used in publicly and privately-funded road construction projects which require overnight or 24-hour traffic control regardless of weather conditions. The system is also less compare to the invested cost in the long run.

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5 Application of the intelligent construction safety traffic light system

There are many possible locations and road construction sites where the utilization of an intelligent construction safety traffic light system is necessary. The wise application of the system would results in various advantages to both the public and road users.

The main application of the system is greatly appreciated in a typical road construction sites
where road closure is necessary. There are many types of road construction nature. The road construction could be two way roads, three junction roads and cross junction roads. The number of traffic light used in one system can be modified according to the need. The master control is capable to communicate with more than one unit of slave unit for operation of more than two junctions.

Apart from that, the system could be used for temporary traffic flow control. Temporary traffic flow control usually is done by the traffic police and is not practically during bad weather conditions. In big cities, traffic flow is very high especially during peak hours. The system can also be used for such applications with the hand held control unit.

There are many more practical applications of the intelligent construction safety traffic light system towards mankind.

6 Conclusion

The utilization of a flagman plays a major role in ensuring both safety and control of the traffic flow in a road construction site. The flagman is always placed in high risk to perform his task as a traffic controller. The awareness on safety signs and safety regulations should be complied by both the contractors and the road users as the first step to avoid unwanted accidents to happen [8 -10]. Appropriate measures should be taken by the responsible authorities in afford to minimized the risk involved to the flagman in a typical road construction site.

New implementation of technology can be a better move or taken as the first step in ensuring the safety of the flagman and the road users. Visualization on the technology growth has shown mass changes to the man kind in many ways in their daily life’s. Such an approach has been taken in developing the intelligent road construction traffic light system which is believed to provide a better and safer indication to both the contractor and public. The system emphasises on the elimination of a flagman from the conventional practice in many road construction sites.

The revolution of an intelligent road construction traffic light system creates a compact solution towards all miseries as highlighted in this research. The implementation of such technology could result in saving thousands of Ringgits in damages and the most important factor is to prevent life losses.

As a road user and also a public conscious researcher in minimizing such miseries, responsible authorities should implement stern punishment to those contractors who fail to comply the road construction safety regulations.

7 Acknowledgment

This paper describes research that is ongoing at the Faculty of Electronics and Computer Engineering to develop an intelligent construction safety traffic light system in support of the humanitarian community. This work is part of the project intelligent traffic light system and was funded by Universiti Teknikal Malaysia Melaka.

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8 References


http://en.wikipedia.org/wiki/Road_traffic_control


