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1. Part A

1.1 Electronic Toll Collection System (ETC)



Figure 1: ETC System in Sri Lanka

An Electronic Toll Collection System is a service that permits the operation of an automatic cashless toll fee collection for vehicles to use bridges, tunnels, lanes, or roads. It is a more prolific alternative than commonly generic toll booths. (DIVISION, 2017-2020)

1.1.1 Discussion

- ETC Systems in Sri Lanka are rapidly ameliorating the transportation industry by successfully substituting conventional toll booths. This stratagem has become a bedrock for innovation, leveraging an increase in throughput and anchoring in congestion management. ETC lanes usher in a substantially eminent increase in capacity in comparison to manual and automatic coin machine lanes. Users can automatically disburse the toll fee, where the payment is electronically debited from the account of the car owner. Followed by this, the toll gates will automatically open, eradicating the necessity of having to halt and perform manual remuneration while passing the toll gate. Not only does this compliment cost effectivity, but it also notably increases the average vehicle throughput compared to normal toll booths. Subsequently, this plays a part in alleviating the reduction of expressway traffic congestion with the adaptment of electronical user fee collection. It is proclaimed that its overall usage aids in the improvement of environmental conditions as it decreases emissions. As a result, this system has transformed the way that vehicles are driven and designed by reconstituting the driving experience with technology. Furthermore, it is majorly cost-effective, due to curtailed amount of operational and maintenance expenses compared to manual lanes. Customers can automatically disburse the toll fee, where the payment is electronically debited from the account of the car owner.
- The receiver of the ETC tollgate is allotted in a high area, meaning that it would receive signals of taller vehicles first. If we consider a scenario where an automobile as large as a bus was situated behind a smaller vehicle, the ETC tollgate would scan the card of the bus before scanning the card of the car. Within that time span, it is ostensible for the smaller vehicle to quickly leave without performing the payment transaction. In congruence, this may result in the bus having to unnecessarily pay twice. It is also apparent that ETC Systems may not perform at an optimum effort in a situation where vehicles do not maintain a specified distance between each other. Moreover, it is mandatory for all automobiles to maintain a particularized distance in

pursuance of enabling the system to work smoothly. Without the specified distance sustained between vehicles, it is feasible for ETC Systems to not perform at an optimum effort.

- The implementation of ETC Systems have exuberantly abetted the reduction of time wastage in highways. In generic toll booths, users are permitted to provide a remuneration to access the highway. According to litigable insights, in ETC Systems, only a time span of 2 seconds is needed to acquire a proper reading and get the system to display the details in the LED screen for the user to see and receive a confirmed payment. The process of physically rendering payments to the counter would enact long queues. With the effectuation of the ETC lane, the queues are abundantly reducing. Once a person has signed up for the option of using the ETC lane, they do not have to wait in queues and waste time, they can just pass through the tollgate within seconds. In vehicles, speed acceleration, deceleration and halting can incite extra fuel consumption. As ETC Systems permit the parallel functions of vehicles passage and toll collection, the reduction of fuel consumption has become attainable. This would also aid in the interests of saving time. When it comes to cost benefits that are in tandem with the utilization of ETC Stations, it is not required to have the same number of employed personnel in comparison to traditional tollbooths. As a result, a significant drop in expenses can be exhibited because of the savings acquired with the elimination of ticket dispensation and manpower. This would inevitably contribute towards the reduction of costs.
- It is indisputably evident that there are insufficiencies found in relation to faultless vehicle scanning. As previously indicated, there is a possibility for certain vehicles to vacate without performing the required payment transaction. This can metamorphose into a dire complication. It would be deemed unethical and unfair to those who are rightfully paying to use ETC facilities. As these problematic insufficiencies have been rectified in ETC Systems situated abroad, the inadequacies related to ETC Systems in Sri Lanka must also be improved.
- ETC System users are usually unable to remember the exact balance that is remaining in their ETC card. As a consequence, users may prospectively try and utilize the system with an inadequate amount of credit. This may lead to traffic congestion within the ETC lane. This could lead to serious complications. As a solution, it would be ideal for ETC System users to be notified as soon as their card balance becomes incommensurate.

1.2 CCTV Camera System



Figure 2: CCTV Camera System

Closed-circuit television (CCTV) cameras are video systems that comprise of premeditatedly positioned video cameras placed around a certain location. It records footage which is disseminated to display monitors for the use of real-time viewing and footage playback. (Bloom, October 25, 2018)

- CCTV cameras are widely used to enhance the security and protection of people, assets, and properties. It is a security force multiplier, accounting access control, real-time surveillance, and intrusion detection. CCTV Cameras also assist in the reduction of crime, larceny and vandalism for a business, property, or residence. Investing in maintaining a CCTV Camera System will help apperceive safety and protection in a higher caliber. It is important to note that attempted break-ins, burglaries happen at night, under the cover of darkness. Properties that do not maintain CCTV Camera Systems are always susceptible to less homeland security.
- In CCTV Cameras, it is likely for motion detection to not be as effective due to certain weather conditions like temperature changes or thunderstorms. The sensors may not work properly due to water seeping in and getting trapped in the system. Weather disruptions are also a considerable rationale when it comes to determining the quality of the security footage. Rain, moisture, severe winds and even heat can insinuate failures and disturbances to the system. Rain droplets can also provoke the diminishment of the camera sensor's performance. This is due to the absorption and dispersion of falling raindrops. Furthermore, heavy downpour can cause the sensors to accidentally detect movement. This is because it may confuse rain droplets for something else. Moreover, CCTV camera footage is infallibly vulnerable to the risk of hacking and for the most part, this would point towards privacy issues. With one loose connection, a CCTV Camera System can mislay all its video feeds. Video retention issues happen because of network connectivity problems, IP address clashes, insufficient power supplies and cabling issues. If the network connection suddenly goes down in your home, this setback is susceptible to occur. It can result in the video flickering on and off, feed going choppy and black, or completely losing all footage.
- One of the most unprecedented benefits of having a CCTV System installed in your home is the possibility to feel safe and secure. It would be possible to remotely monitor activities and keep records of individuals that are entering and leaving the premises, including other multitudinous occurrences. CCTV recordings are effectively beneficial and invaluable to the detection of burglaries and the depletion of criminal offence investigations, making it easier to gather evidence. Simply installing a camera in plain sight could play a role in dissuading potential burglars and intruders. In case if your home is broken into and a crime does occur, it is more than possible to see and capture the unravelment of entire incident via CCTV. This would greatly assist in revealing the suspects that were involved in an incident, location of incident, transpiration of events, location of event, etc.
- Regardless of continuous advancements in technology, it almost always seems like security footage tends to exhibit a lack of quality in deterring conditions. CCTV Camera footage can look grainy and blurry because of compression and overall file resolution. As a compromise, pixel interpolation, sharpening and warp stabilization should all be implemented more in CCTV Camera Systems.

- If the CCTV camera footage video signals are not transmitted via proper media, it would result in the overall performance downgrading. In furtherance of ensuring the highest video image quality, it is necessary to follow proper video media transmission techniques.

2. Part B: Paddy Field Irrigation System.

Sri Lankan paddy fields significantly play a part in contributing towards flood control, food security and groundwater enrichment. With the hardships that climate change impacts have ushered in, a more pragmatic approach to issues and inadequacies must be established. A reliable Irrigation System is immoderately important to efficient paddy cultivation.

The proposed system will aid water and irrigation professionals in regulating the water management in paddy cultivation settings. This system will accommodate features like automatically opening and closing pipelines that carry water, with the farmer controlling the supply of water disbursed. It will also possess a water level measuring sensor and a water quality sensor. These sensors will play a role in notifying the farmer through his/her mobile device. The gathered data from humidity, temperature and soil moisturizing sensors will automatically prompt the system to instigate the automatic response of pipelines opening and closing (for water discharge).

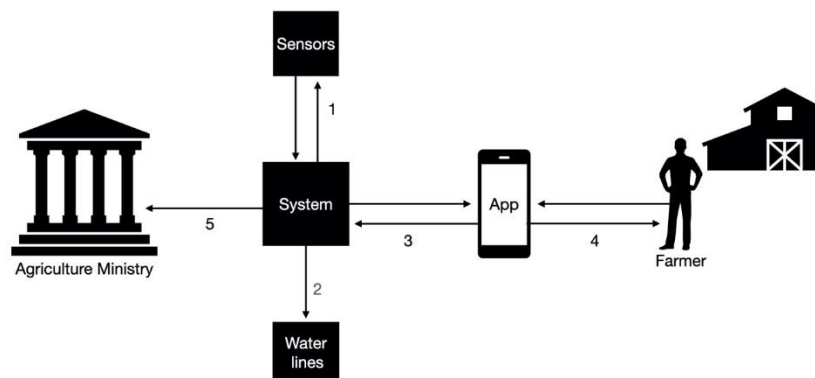


Figure 3: Project explanation Diagram

Paddy Field Irrigation System comprises of a DHT11(temperature sensor), a humidity sensor, an agricultural light sensor, a YL – 69 (soil moisture sensor), a water level sensor and an electro-chemical sensor. These sensors would acquire and send the collected data into the NodeMCU. The NodeMCU has an inbuilt Wi-Fi module, and the readings are sent to the app for statical overview, which will later help with the agricultural sector of Sri Lanka.

It is possible to run this system in two ways. The first method would follow a fully automated approach. If the temperature, moisture, and humidity readings are not precise at any instance, it would send signals to the system. The system would eventually send signals to the sensors. At indication, the sensors that are blocking the water supply will proceed to unblock to allow the water to start flowing into the paddy fields.

The second method would follow a manual approach. If the sensor readings are not up to par, a notification will be sent to the user, indicating that a certain action must be consummated. The user can choose one of the two options; to analyse and get the situation under control or completely ignore the notification. If the user decides to get the situation under control, then he/she can unlock the necessary pipelines to allow the flow of water. This would help in maintaining the needed sensor readings.

Once the user utilizes the system for more than a month, the respective monthly statistics would be sent to the agricultural department. There, the statistics would be analysed to acquire any fundamental information. This information would be considered and applied for the betterment and improvement of the agriculture sector of Sri Lanka.

Paddy Field Watering System uses sensors which will be sending readings to the inbuilt Wi-Fi module, all these readings will play a major role on the proposed system. These readings will later be used in the monthly and daily statistics, which will be sent to the agricultural department for future needed evaluations and decisions to be made for the betterment of the agriculture sector as one.

2.1 Features of the System

2.1.1 Humidity Sensor

The humidity sensor will measure the water vapour of the environment. The readings obtained by the humidity sensor will help in regulating the humidity of the environment. The readings obtained will be sent to the agricultural department for further evaluation.

2.1.2 Agricultural Light Sensor

The Agricultural Light Sensor will play a role in controlling and keeping track of the amount of light scintillating on the paddy field. It will determine whether the plants are receiving adequate or excessive light. Based on the ambient light levels, the sensor will control and permit plant growth accordingly.

2.1.3 Temperature Sensor

The temperature sensor will measure the temperature of the air and soil. It will monitor the machinery that collects the plants in addition to the plants that are already gathered. The temperature sensors will emit signals whenever the system requires minor maintenance, is underperforming, or is critically malfunctioning.

2.1.4 Soil Moisture Sensor

Soil moisture sensors play a role in measuring the amount of moisture in the soil at any probable time. The integration of soil moisture sensors would make it much easier to schedule water supply distribution periods. An interesting feature that is coupled with soil moisture sensors is that the more of them you utilize them, the more accurate they become.

2.1.5 Water Level Sensor

Water level and flow sensors can be used to detect any open water channel discharge. This would aid in estimating the future water availability more accurately. Groundwater level sensors can also be used for similar goals, such as maximizing the use of groundwater in agricultural applications.

2.1.6 Electro-Chemical Sensors

Electrochemical sensors contribute towards providing pH and soil nutrient concentration information. It is greatly useful for precision agriculture. The sensor electrodes work by detecting ions within the soil. When it comes to assessing soil fertility, electrochemical approaches have proven to be effective.

2.2 Requirements

2.2.1 Hardware

- DHT11(temperature sensor).
- Humidity sensor.
- Agricultural light sensor.
- YL – 69 (soil moisture sensor).
- Water level sensor.
- Electro-chemical.
- NodeMCU.
- Pipelines.

2.2.2 Software

- Arduino complier.
- Java programming language.
- Android Studio.

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