IOT BASED ELECTRICAL DEVICE SURVEILLANCE AND CONTROL SYSTEM

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Abstract - This paper deals with the idea of an energy saving electrical device surveillance and control system. The backbone of this project is IOT. IOT describes network of physical objects that are embedded with sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and system over internet. A large amount of energy is consumed by lighting appliances, so making improved efficiency and quick fault detection is a significant challenge. Moreover, detection of traffic rule violation especially speed detection of vehicles in night are done and necessary actions are also taken. For this purpose, we utilize sensors and cameras.

Keywords: Control system, IOT, Sensors

1.INTRODUCTION

Main purpose is to implement an energy saving electrical device surveillance and control system based on IOT. Detection of traffic rule violation and taking necessary action during night time.

We utilize camera, web-based portal, hardware equipment's to demonstrate an energy saving electrical surveillance and control system. If human being or any physical objects are detected in camera, the corresponding data will be passed to database and the streetlight can be turned ON/OFF accordingly. Also, if needed, street light can also maintain in ON condition. Sensors are used for detection of traffic rule violation in night.

It is important to setup an energy saving electrical device surveillance and control system. Current version of electrical device surveillance is not efficient to reduce energy consumption. So, as we automate this with the backbone of IOT, we can reduce energy.

2. LITERATURE REVIEW

2.1INTERNET OF THINGS (IOT)-BASED, SOLAR POWERED STREET LIGHT SYSTEM WITH ANTI-VANDALIZATION MECHANISM

Street lights are lamps mounted on a post for the main purpose of illuminating the environment during the night time. It is a raised source of light on the edge of a road or path. In today's world, street lighting is a major requirement for the avoidance of accidents and general safety along the roads. Street lighting is one of the major infrastructures that demand a lot of power. The demand for power is one challenge that will continually concern developing countries. It is therefore pertinent for the government to look into more efficient ways of powering street lights. There is need for sustainable energy supply and this necessitates the exploration of available energy sources. Among these, renewable resources are most sought after. Renewable energy is energy generated from natural resources (i.e.) sun, wind, rain, tides, and can be generated again and again as and when required. They are abundantly available and by far the cleanest sources of energy available on the planet. Besides energy efficiency concerns, this research is majorly focused on addressing the issues of vandalization which have plagued the government installed solar street lights over the years. Overall, this work is centered on developing energy efficient and environmentally friendly street lighting system that has functionalities to combat vandalization. In this wise, firstly, the street light is designed with carefully selected components that will miniaturize the system such that instead of split unit installations, a compact installation (having all the components, except the solar panel, in one compartment) can be achieved. Also, instead of lead-acid batteries, lithium-ion batteries are used for better power efficiency. Thirdly, relevant mechanisms for remote monitoring and tracking of vandalization are incorporated into the system. This is achieved by employing the emerging, state-of-the-art Internet of Things (IoT) technology. The components used in this system are: Arduino Wi-Fi module (ESP2866MOD), IOT module (Particle Electron 3G), Flying Fish infrared sensor (IR) module with adjustable distance, ULN2003 driver IC, LED array,18650 cylindrical lithium-ion batteries rated 3.7V, 2200mAh, LDR, SARODA SP09-05 model solar PV module rated 18V, 20W, wireless router and a computer.

2.2 IOT AND CLOUD CONVERGENCE: OPPORTUNITIES AND CHALLENGES

The Cloud Computing concept has greatly matured over the last few years. The concept means that anything that can be hosted on the Internet, i.e., resources/services/data is available for use, when needed, for the composition and provision of more sophisticated services. Key cloud characteristics are: OnDemand service provision, ubiquitous access, resource pooling, as well as elasticity. In the meantime, the "Internet of Things" (IoT) vision has evolved and is coming to reality. The IoT involves several billions of diverse devices inter-connected by 2020 vast amounts of quickly-emerging/versatile data (i.e., "big data"), and numerous services. Connected devices can be sensors, actuators, smart phones, computers, buildings and home/work appliances, cars and road infrastructure elements, and any other device or object that can be connected, monitored or actuated. Devices are connected to the Internet, as well as with each other, via heterogeneous access networks. Services aim at leading to a smart, sustainable and inclusive society and economy. In the light of the issues discussed, the success of the IoT services can only be achieved if they are attributed with ubiquitous accessibility (i.e., more business opportunities), reliability (e.g., for handling context/policy changes and accomplishing trust from the parts of the users), high-performance (e.g., due to the associated "big data"), efficiency (for improving the position of all stakeholders, e.g., providers and users), and scalability (e.g., as various volumes of users, resources and data may be involved in service provision). The Cloud features mentioned in the first paragraph are essential today for the IoT world. For instance, resource pooling enhances the reliability and efficiency of service provision, the on-demand and elasticity features are fundamental for efficient and scalable service provision (resource provision where needed, for the amount of time needed), etc. All these facts make a more than compelling case for the merging of the Cloud and IoT paradigms. Cloud computing relies on sharing of resources, which is key requirements for IoT platform. The Cloud Computing is not only sharing the resources but also maximizing the resources. It is also location independent; the users access the cloud services from any location and with any devices through the internet connection. When we talk about the IoT platform then it should also be access from anywhere, any time. The virtualization of physical devices is another important characteristic, virtualization allow users to easily share the devices. Due to virtual world nature, it is also more homogeneous. Multitenancy feature of cloud computing enables sharing of resources to multiple users over spatial and time distribution. In addition, Cloud offer elasticity and scalable of resources and application, the service and resources are easily accessible and available. Hence the convergence of Cloud and IoT can provide huge opportunities for both technologies. Two main approaches for this convergence are foreseen i) Cloud-based IoT which is to bring IoT functionalities into Cloud ii) IoT-Centric Cloud which is to bring Cloud functionalities into IoT. This convergence has substantial impacts on both sides. For IoT to provide cloud computing functionalities, to support on realization of IoT vision. For Cloud, IoT to provide huge opportunities for cloud services. In the following session we have described the IoT-Centric Cloud approach.

2.3 A NOVEL IOT ACCESS ARCHITECTURE FOR VEHICLE MONITORING SYSTEM

The Internet of Things (IoT) is an emerging technology which was first proposed to study RFID by Ashton, Professor of the MIT Auto-ID Centre in 1999. IoT is a major drive to support service composition with various applications. It enables objects surrounding us with the ability to communicate each other through the Internet. It consists of three layers: perception layer, network layer and application layer. Sensors, Actuators, RFID tags and other smart terminals are connected to the IoT from the perception layer. Network layer is responsible for the communication between "things" and human beings. Abundant applications are provided by the application layer. Three-layer architecture of IoT. Compared to traditional Internet, IoT mainly enables "things" to communicate with each other. Since the number of "things" is large and heterogeneous in nature, how to provide unified access to the IoT for various "things" is the fundamental and key issue for IoT applications. At present, there are a lot of systems and interface equipment on the market. However, most of them work in specialized environment and could only access a very limited number of devices with specialized interfaces. To address this problem, we design and implement a novel IoT access architecture for various IoT devices. On one side, IEEE 1451.2 is adopted to support various sensors, actuators and transducers for data acquisition. On the other side, we implement this design with FPGA and SoC technologies, which can make the entire system easily reconfigurable while consuming low power. The architecture supports data acquisition, processing, storage and transmission functions for all kinds of devices and equipment under the IoT environment. This design can be widely used in different areas in the IoT environment for Realtime monitoring, environmental data acquisition and equipment control. In this design, we have adopted IEEE1451.2 standard as the reference to access multiple sensors, actuators and transducers. The standard stipulates a series of specifications from sensor interface definition to the data acquisition. In order to reduce the consumption of system hardware resources, we have adopted FPGA to implement the whole system. A variety of specific IP cores are designed and incorporated in this design. Meanwhile, under the coordination of SoC technology, the main module of the system is implemented on a single FPGA chip. The system is mainly divided into two main parts: master module and data acquisition module, and the two modules communicate through the universal asynchronous receiver/transmitter (UART) interface. The data acquisition module is responsible for accessing multiple sensors and collecting environmental information. It can support both analogue and digital signal inputs through analogue-to-digital converter (ADC) and digital-to-analogue converter (DAC). A coprocessor is implemented with IP core conducts control and signal disposal of the whole module. Standard, transducer electronic data sheet (TEDS) is used to describe the type, operation and attributes of sensors, actuators and transducers, which is implemented and stored in block RAM (BRAM) in this design. As the major unit of the whole system, the master module provides other core functions: network communication, local storage, etc. Besides, the master module provides interfaces to access those high-speed devices such as digital camera. An ARM Cortex processor is adopted as the main controller with high performance, reliability and stability. With this design, the system can access various kinds of sensors, actuators and other high-speed devices in IoT environment. The specifically designed data acquisition module undertakes data acquisition tasks, which enables the master module focus on the complex tasks such as network communication and local storage.

3.PROPOSED WORK

Currently we are using LDR based streetlight system. In the LDR based system energy consumption is very high. So, propose an IOT based electrical device surveillance system to reduce energy consumption. During night accidents are more to occur due to lack of checking from authorities. Therefore, we can identify those vehicles with overspeed and can also detect the respective number plate.

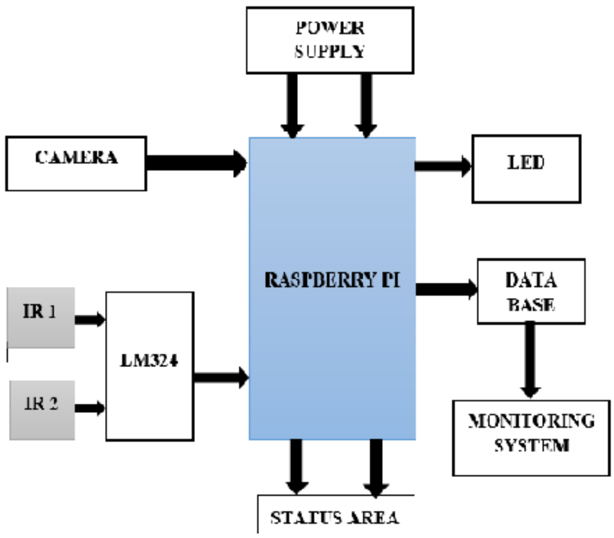

FIG-1-BLOCK DIAGRAM

The working of a system consists of streetlamps, sensors to direct the flow of current related to control on/off mechanism of the device. Sensors used to control electrical appliances and sends the analogue signal to the system and perform the related task. Master end consists of raspberry Pi controller the purpose of microcontroller is to take data from all Street lamps through wired connection and convert them into serial communication. The signal is transferred through sensors the microcontroller detects the signal and perform appropriate task. In case of detecting failure of street lamp the electrical device end which receives information through sensors and at the other and raspberry Pi which receive information and sends the data to monitoring system for visual display status and received signal is stored in the database. For the detection of traffic violation capturing the number plate of over speeded vehicles we use IR sensors to check the speed of vehicle if they are over speeded the number plate will be captured by the camera. For the speed detection we use two IR sensors one at entering path and one at the leaving path. When vehicles cut both sensors, the time will be calculated and camera will capture the number plate according with the speed of vehicles and then raspberry Pi receives information through LM 324 IC and send the data to monitoring system. With the help of status area we can check that our system work properly without any defect.

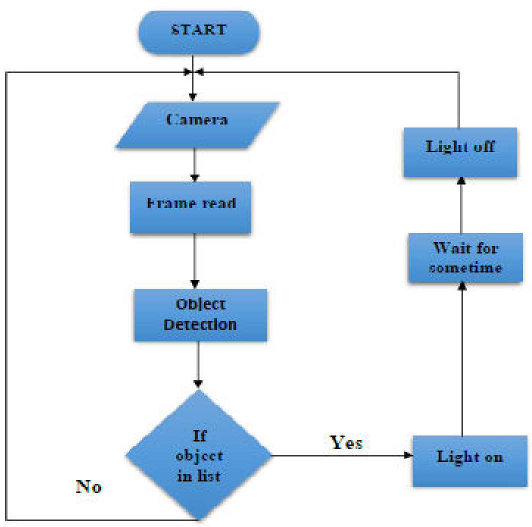

FIG 2- FLOW CHART OF AUTOMATIC STREET LIGHT CONTROL

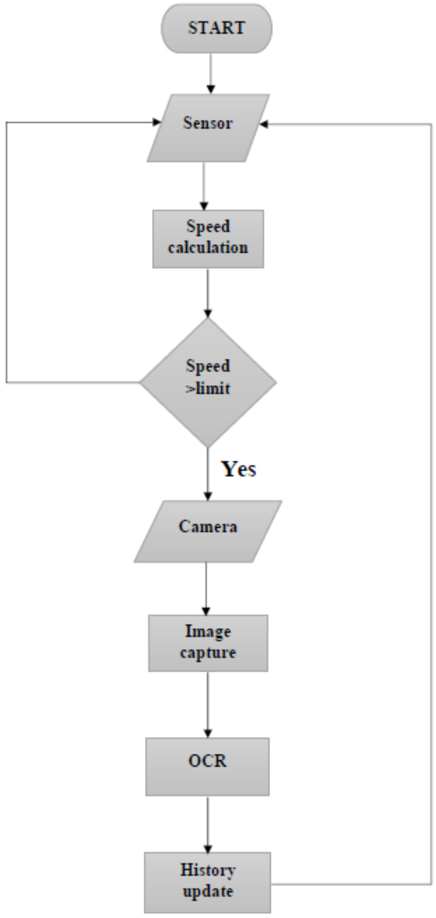

FIG 3- FLOW CHART OF OVER SPEED DETECTION

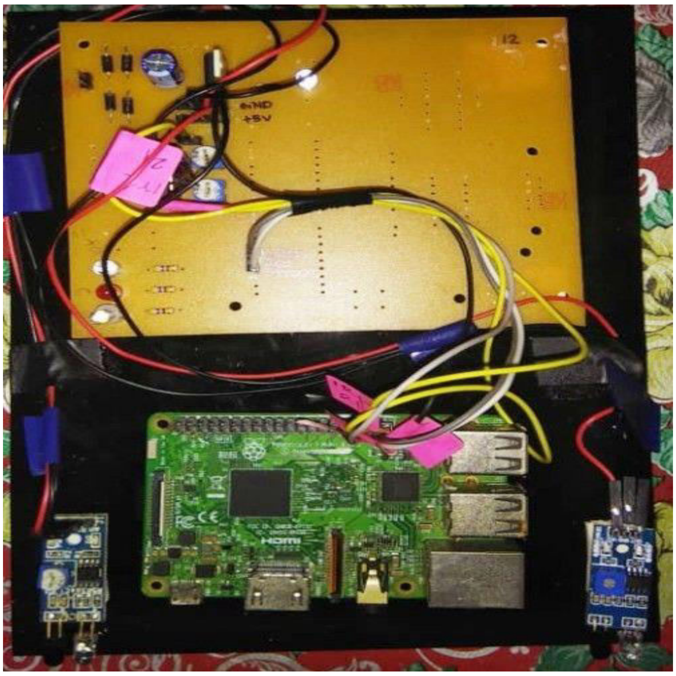

FIG 4 -EXPERIMENTAL SETUP

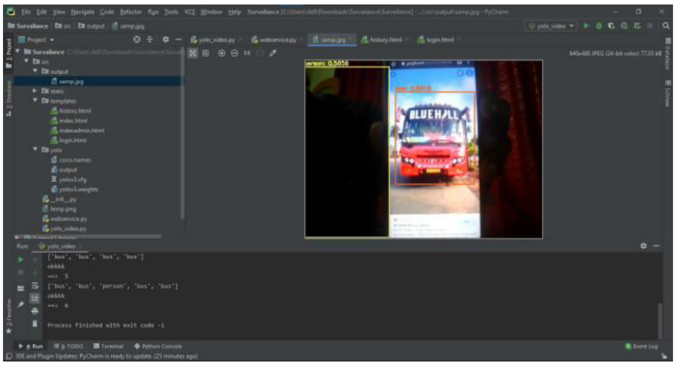

FIG 5 -OBJECT DETECTION

Fig 4 shows the experiment setup for electrical surveillance system. The following hardware components were used in this system.

Raspberry Pi 3

Raspberry Pi 3 Model B+ features a 1.4GHz 64-bit quad-core ARM Cortex-A53 CPU Broadcom processor. This single board computer provides dual-band 2.4GHz and 5GHz wireless LAN and Bluetooth 4.2/BLE. The Raspberry Pi 3 Model B+ offers faster Ethernet (Gigabit Ethernet over USB 2.0) and Power-over-Ethernet (PoE) capability via separate PoE HAT. This single board computer also provides improved Preboot Execution Environment (PXE) network, USB mass-storage booting, and improved thermal management.

FEATURES

Broadcom BCM2837B0, Cortex-A53 64-bit SoC at 1.4GHz

Dual-band 802.11ac wireless LAN

Bluetooth 4.2

Faster Ethernet (Gigabit Ethernet over USB 2.0)

PoE support (with separate PoE HAT)

Improved PXE network

USB mass-storage booting

Improved thermal management

SPECIFICATIONS

1GB LPDDR2 SDRAM memory

5V/2.5A DC power input (micro-USB) power supply

WIRELESS CONNECTIVITY:

2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN and Bluetooth 4.2/BLE

Gigabit Ethernet over USB 2.0 (maximum throughput 300Mbps)

4 x USB 2.0 port

Extended 40-pin General Purpose Input Output (GPIO) header

Full-size HDMI video output

4-pole stereo audio output and composite video port

Camera Serial Interface (CSI) camera port for connecting a Raspberry Pi camera

Display Serial Interface (DSI) display port for connecting a Raspberry Pi touchscreen display Micro SD port for loading your operating system and storing data

0°C to 50°C operating temperature range

120mm x 75mm x 34mm dimension

Weighs 75

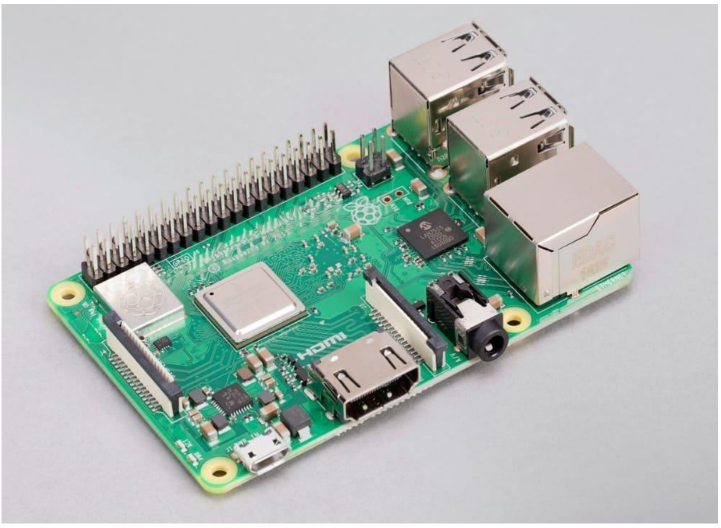

FIG-6-: Raspberry PI

LM324

The LM324 operational amplifier IC can be worked as a comparator. This IC has 4 independent operational amplifiers on a single chip. This a Low Power Quad Operational Amplifier and it has high stability, bandwidth which was designed to operate from a single power supply over a wide range of voltages. The quad amplifier can operate at supply voltages as low as 3.0 V or as high as 3.2 V with quiescent currents about one fifth of those associated with the MC174.

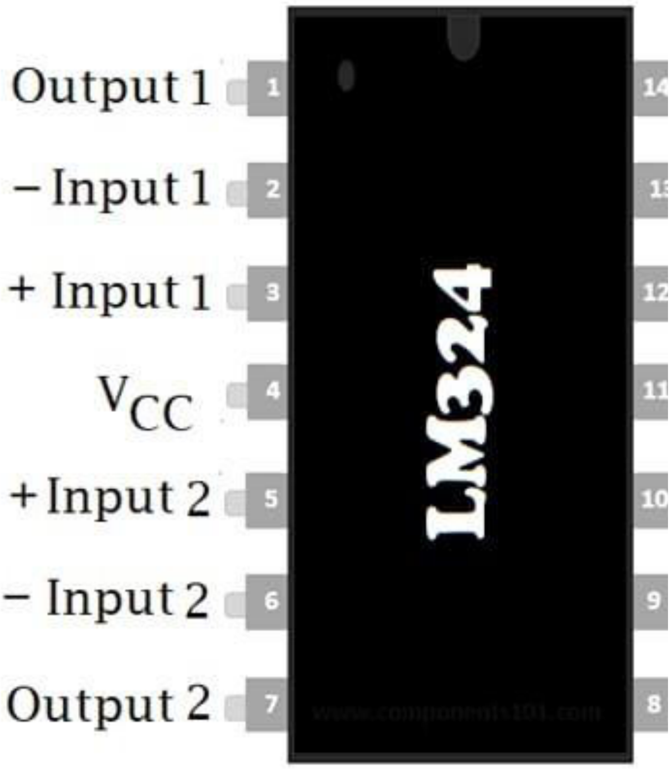

FIG-7: LM324

USB Camera

USB Cameras are imaging cameras that use USB 2.0 or USB 3.0 technology to transfer image data. USB Cameras are designed to easily interface with dedicated computer systems by using the same USB technology that is found on most computers. The accessibility of USB technology in computer systems as well as the 480 Mb/s transfer rate of USB 2.0 makes USB Cameras ideal for many imaging applications. An increasing selection of USB 3.0 Cameras is also available with data transfer rates of up to 5 Gb/s.

FIG-8 : USB Camera

IR Sensors

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment There are two types of infrared sensors: active and passive. Active infrared sensors both emit and detect infrared radiation. Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems and passive IR only detect infrared radiation they are most commonly used in motion-based detection IR sensor provides a digital as well as analogue output. The working principle of an infrared sensor is similar to the object detection sensor. This sensor includes an IR LED & an IR Photodiode, so by combining these two can be formed as a photo-coupler otherwise optocoupler.

FIG8:IR sensor

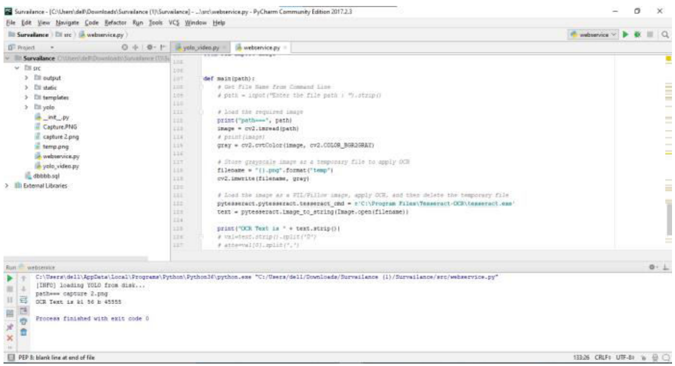

FIG 9-NUMBER PLATE DETECTION

FIG -10- OUTPUT OF THE DATABASE

3. CONCLUSIONS

This IOT based device surveillance and control system is exclusively used to keep surveillance on the electrical devices working condition and also to control the on/off functionality from a central remote location. The designed system works efficiently for both indoor and outdoor lighting. On the other hand, it drastically reduces the electric energy consumption. Also, this system contains surveillance camera which is used to detect traffic violation and all this data is where stored in database for future references. This system can be installed as energy efficient system to control street lamp that requires a lot of energy and needs manual intervene.

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