Raspbian Magic Mirror-A Smart Mirror to Monitor Children by Using Raspberry Pi Technology

R.M.B.N. Siripala[1], M. Nirosha[2], P.A.D.A. Jayaweera[4], N.D.A.S. Dananjaya[5], Ms. S.G.S. Fernando[6]

Faculty of Information Technology, Sri Lanka Institute of Information Technology,
Colombo, Sri Lanka

Abstract- It is a universally accepted truth that raising a child is an extremely responsible task. One of the major problems faced by parents/guardians nowadays is monitoring their children while they are away at work. To monitor them constantly, there should be a system that can be easily handled, user friendly and smart in accordance with the rapid advancements in technology. Though the applications of Internet of Things (IoT) are diverse, this system is based on IoT which will be implemented by using Raspberry pi technology. It is a smart mirror which will possess the ability to display advanced details and connect with the user's smart phone by using an Android application. Even though many smart mirrors have been developed previously, they had only a few features such as displaying the date, time, weather and news feeds. But the Raspbian mirror which is demonstrate in this paper is much more interactive and advanced and will primarily target working parents which will receive notifications from the users through their smart phones. The Raspbian magic mirror will display useful information such as the date, time, weather and daily reminders, but it will also help parents to monitor their children and assist them with their studies, and to organize their daily routines. In the case of teenage children, parents could use this mirror to assign them household chores as well. This device could of course be used as an ordinary mirror including all the above features that make day to day life easier and faster, which is an integral part of home automation as well.

Keywords: Internet of Things (IoT), Raspberry Pi, Home Automation, Mirror, Android

I. Introduction

In today's complicated world, efficient parenting becomes more important, and parents and guardians must educate and bring up their children in a technologically advanced environment. Children need the guidance of their parents more than ever. Yet, in today's busy world, where both parents are normally employed, or in the case of single parents, this is quite challenging. However, this problem could be overcome through a revolutionary device called the Raspbian Magic Mirror that can be implement using Raspberry pi technology, which will be the subject of our research based on IoT.

The smart mirrors introduced by tech companies' offer many services in addition to playing the conventional role of a looking glass. They act as digital screen and display important information such as reminders, news feeds, calendar, time and weather forecasts. However, the smart mirror as proposed by our research differs from current products since it targets families and provides an interactive platform for parents/guardians to monitor their children while they are away at work, to enable them to assist them with their studies and to make sure their

children are safe at home, in addition to the features available in other smart mirrors. This reduces the time available for them to communicate with their children and to make sure that they are safe. It will also enable teenagers to make responsible at their work. This will be especially useful in the case of differently abled children, since they would require more adult supervision and attention from their parents. The main focus is to save the time of working parents, enable efficient parenting and make day to do life easier and faster which is an integral part of home automation as well. Raspbian Magic Mirror is a smart mirror which will possess the ability to display advance details and connect with the user's smart phone by using an Android application.

Since the Mirror is the first device of its kind to be introduced to the Sri Lankan market, it will enable us to rapidly gain market share and achieve and maintain the status of market leader in Sri Lanka. So far, Raspberry technology is currently not popular within the Sri Lankan market, we believe the introduction of an interactive device of this nature will improve the popularity of Raspberry technology and assist in the development of various other useful applications using this technology. In Section 2, will discuss the existing literature that is available with similar studies from other parts of the world.

II. Background and Related Work

Since this research is based on IoT using Raspberry pi technology, the background study was conducted to identify existing similar systems in order to get a better result. Raspberry technology has been used in many advanced applications with advanced results. This review mainly covers the methodology followed in the background study, including the advantages and disadvantages of the system.

One is about a smart mirror which is an interactive system which possesses limited features such as displaying the date, time, and current weather condition and outside temperature and news feeds. However, it can simply display the information which is available on the Internet and cannot connect with the smart phones using an Android application. This smart mirror lacks many features and people cannot send notifications to the mirror, which is its main disadvantage which has not been resolved until now [1].

The existing research which is about an Environment Monitoring System can remotely monitor environmental parameters such as temperature, humidity, amount of CO_2 in air and many more in a given environment at any scale using sensors such as DHT11 Digital Humidity and Temperature Sensor, ADIS16220 Digital Vibration Sensor and LPG Gas Sensor - MQ-6. Raspberry-pi used as the main board and sensors will collect all the real-time data from this environment and this real-time data will be fetched by the web server and displayed. This system can monitor most

of the parameters in the environment and it is capable of many other practical uses including monitoring of temperature and humidity in a house, outbuilding, greenhouse, or even a museum [2]. Mendrela et al. [3] present a Patient Monitoring System which can be used to wirelessly monitor patients. The physiological parameters such as temperature, blood pressure, ECG and level of saline are measured through WSN (Wireless Sensor Nodes) using sensors such as Temperature sensor- LM 35, Blood pressure sensor, Level Detector, ECG electrodes and RF modules. This will improve the normal life of patient by reducing the risk of infection and severe conditions when the doctor or nurse is not nearby. But the major problem of this system is the difficulty to monitor symptoms that are not externally visible such as depression and mental disorders [3].

V. Ramya et al. [4] discussed a secure and energy efficient Wireless Industrial Automation system which is based on Raspberry pi technology. It controls industrial devices, manages power utilities and also monitors the employee activities. These are all done through Wi-Fi network with help of server PC. This server PC is password protected and it can be opened only by the authorized person. They have been mainly focused on reducing the power consumption and to alert the people about the critical situations in the industry. This system prevents more accidents and provides more security and privacy to the organizations like industry, education and hospitals.

This is a system using Raspberry pi on children tracker application is for children safety protection. This system for guidance the user to detect the coordinate of their children. In system development part, this communication process is started from the system able detect the children coordinate and send it to the user web server. Raspberry Pi is the main controller of this system. Over all the system is user friendly and it allows to track the child anytime anywhere in any weather condition [5].

Home automation is one of big area of Internet of Things (IoT) gives huge benefits and also give little bit disadvantages. PIR sensor, Temperature sensor , Smoke or gas detector sensor, Heater and water level sensor all sensors together create proper understanding about how manage the system. Smita et al. [6] presents the application of IoT for Smart Home Automation system which includes a Raspberry Pi as a processing unit for data which is extracted from various sub-systems like, Temperature sensing system, Automatic light system, Cooling system, and Gas detection system, Water level sensing system, Motion detection system and Lights on and off system. With low cost raspberry pi module implement the intelligent processes through ARM1176JZFS processor and connected decisions and monitoring through the internet [6].

Accessing interconnected devices using internet through TCP/IP concept is most secured and efficiency way. It may depend on measuring sensors data, controlling home appliance, monitoring live status of devices and etc. [7]. This research introduces methodology for developing embedded web server system which uses SOC platform that can remotely acquire and control data for those people having the disabilities like elderlies, visually impaired, hearing impaired. This project uses hardware as Raspberry and TCP/IP, which provides high bandwidth, economy and compatibility. TCP/IP allows the different computing devices to access the web page which provides greater security, the user can browse web page from different area using the home area network/internet.

Fuead et al. [8] present a device which will accommodate the egg hatching procedure without the usual process. In addition to that, a monitoring system has also been developed so that the user can have continuous accesses to the device. Most importantly, its purpose is to create an environment where the egg incubation process occurs in a more orderly and safe manner. This system ultimately has managed to provide an optimum environment for the egg-hatching process. It enables to control the heat, moisture and humidity of the incubator and rotate/spin the egg tray for every six hours. But if there is at least one issue in a node, sits cause for whole system [8].

The research 'Smart Helmet' is an Intelligent Safety system for Motorcyclist using Raspberry-Pi [9]. It extracts moving objects and classifies them as a motorcycle or other moving objects. From the noticed motorcycles it detects motorcycle riders and determines that they are wearing helmets or not. The system classifies the head as wearing a helmet or not using KNN based on features derived from 4 sections of segmented head region. The benefits of introducing this system is improving safety and reduce accidents, especially fatal to the motorcyclist, reducing workload of Traffic Policemen. And also the system is low costly and less complexity. But its performance can be limited at several weather conditions and also this system is developed for Small area [9]. Another system based on ZigBee telecommunication mesh wireless network and Raspberry Pi control card is realized for a complete remote management of an isolate high efficiency street lightning system. The system uses devices and sensors to manage the single street lamppost and to send information by a ZigBee TLC network to a central lamppost equipped with a Raspberry-Pi control Card able to collect and elaborate information. [10].

The system as the name indicates "Android based home automation" Controls Home appliances via Android device using Wi-Fi as communication protocol and Raspberry Pi as server system [11]. A novel architecture for a home automation system is proposed using the relatively new communication technologies. A user-friendly interface for the android device allows the user to communicate with the Raspberry Pi server. This system is scalable and cost effective, portable and have a wide range of capabilities. Also, its decreases the installation cost and effort, providing security and authentication, and the additional vendors can be easily added to the system [11].

III. METHODOLOGY

Section 3 discusses about each phases of prototype methodology which has been used for the development of Raspbian Magic Mirror, procedures of tasks in each phase and materials produced at each phase of System Development Lifecycle.

Planning

The preparing the project charter, WBS and the Gantt chart represent proposed project plan for development of the magic mirror by planning time and scheduling the time duration of the research is considered to be the first step to implement this system.

Preparing the budget comes as the next step of the planning where its provides a financial framework to the research and managing a reasonable expenditure within a scheduled time period is the main target of the project.

And the next step is the feasibility analysis. The main reason to do a feasibility study in the beginning of the project is to find out if this project is technically achievable and also economically profitable within the estimated cost.

Analysis

Requirement gathering, and analysis step have been allocated a large amount of days, because it forms all the development steps and all expected processors will depend on it. It has main two approaches as primary and secondary data. Where in primary data, specific questionnaires that indicates the goals of the system were made and distributed within a sample of sixty population to get their responses to make conclusion with that. The initial sample size was 70 and after the questionnaire was conducted the response count was from 66 individuals. The analyzed data demonstrates that due to parents' busy social life style it has affected the Child behavior, Social life style, Collaboration, Physical health, Technology factors and the time management of monitoring the children by the parents.

The secondary data consists of the information, specifications and the limitations that would be gathered by going through the former research papers that has done through the same research stream. By that it would help the research group to get a better idea to implement the system by avoiding the former issues that research groups have being faced.

According to that, gathering and analyzing data has been a crucial and very important phase of this project since it helped to narrow down the requirements and elaborate the requirements narrowed down. Through the questionnaire the project team has being able to recognize the target users, the user expectations from the application. The application will be designed to a specific group of parents with necessary resources required from the application. Recourses vary from financial to non-financial factors such as education, living environment, and life-style. It is safe to expect the application to be a success because overall analysis of the gathered data provides positive results on having users with the need of such application and willing users to accept such help.

Design

Designing the system comes as the next phase where it looks forward to do the designing of the system which includes Mirror's design, User interface design and Mobile application design.

Fig 1 depicts the High-Level Architecture diagram of Raspbian Magic Mirror at this phase and Fig 2 depicts the Hardware design diagram of Raspbian Magic Mirror sketched at this phase.
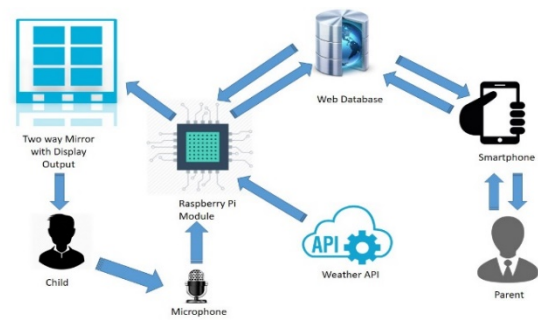

Figure 1: High Level Architecture of the system
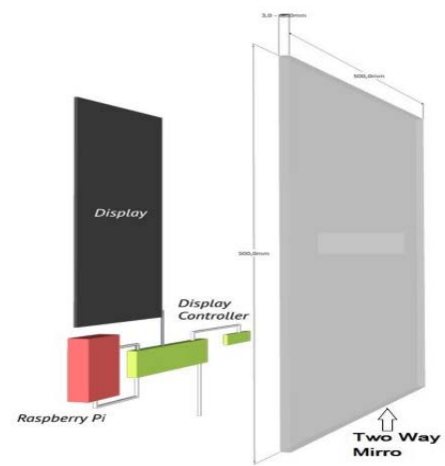
Hardware model of Raspbian Magic Mirror:

Figure 2: Hardware Design of the System

Designing these three main sections act an important role because an attractive mirror makes users attract towards it making it expose to the marketing level. And user interfaces and the mobile application must be eye touching.
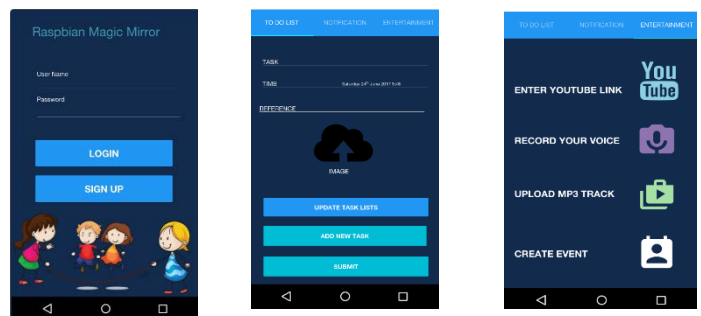

Figure 3. depicts the

m

the

communicate with the child using the smart mirror.

Figure 3: Main Interfaces of Android Application (a, b, c)

Implementation

Once the system design is received the implementation phase begins as the most time allocated phase. It consists of two main

sections such as hardware implementation and software implementation

At the hardware implementation, the physical mirror body is designed with the Two-way mirror, LED Monitor and the Raspberry Pi Circuit. Coding the program is done at the software implementation where it again classified as frond end programming and back end programming. Database is also implemented and integrated to the same system within this phase.

Software Platforms and Languages:

➢ Application Running on Raspberry Pi: Electron Framework which is used JavaScript, HTML5 and Node JS

➢ Mobile Application: Android Framework using Java Language

➢ Web Application: Angular JS

➢ Database: MongoDB that is using Non-Structured query language

Testing

Testing is the last phase that helps to evaluate the quality of the program and also for improving it, by identifying defects and problems. Also, it verifies and validate that the program has meets its requirements. Testing is done in three ways such that unit testing, integration testing and system testing respectively.

Unit testing comes under black box technique method and the individual units/ components of a software are tested. In the integration testing individual software modules are combined and tested as a group. Software testing where a complete and integrated software is tested. It evaluates the system's compliance with the specified requirements.

IV.   RESULTS AND DISCUSSION

Section 4 discusses the results and their discussion that the research team achieved from the research project. The important implications of the research findings, regardless of the statistical significance of this research are discussed below. Further, Identifying the defect and limitation of this project can be useful for future researchers in order to continue their research.

The purpose of this project was to develop a Smart Mirror which is fully functional monitoring system for parents, where helps the parents to remind/encourage (to-do-list) their children in studies and extracurricular activities and get them to work by sending notification. It will be very easy for the parent to monitor their children while they are in the work. The system consists of two areas such as Smart Mirror and the android application. The basic object of the Mirror is to view the task (reminder) which is send by the parents and to send a reply to the parent by the voice command whether the task is done or not. And the android application will be used to send tasks and monitor the children. It will make the child more interested in doing their home works and day to day activities.

Fig 4. below shows design and hardware implementation of the Raspbian Magic Mirror.

Fig 5. below shows how the mirror works when the parents send the to-do-list and task to complete and Fig 6. shows the virtual interface of the mirror.

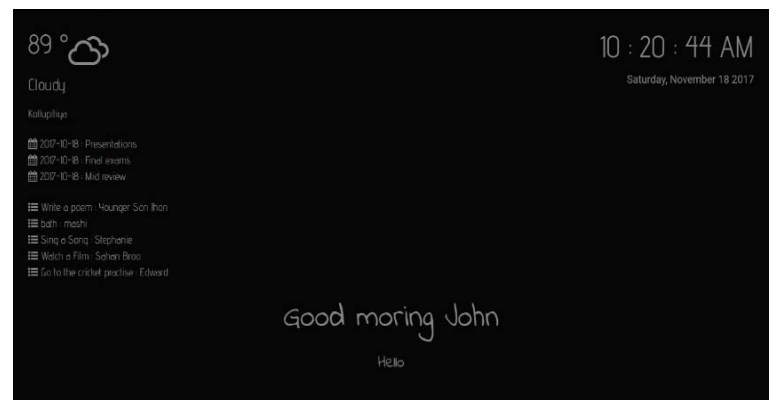Figure 5: Real Mirror Interface

Figure 6: Virtual Interface of the Mirror

Main objective of this project was to present a system which is fully functional and covers colors, designs, words, and to encourage children activities. The use of the system could happen in any geographical area. So, the child will be performing actively with interest and pleasure.

The interfaces of the Mirror have designed specifically for the children. The system is user friendly and the interfaces are colorful and attractive. The functions had to be carefully chosen which allows users to work with the system for a long time. Applying needed functions were problem that occurred during design phase. This was solved by discussion between team members.

There were many technical problems that are faced by the research team during the development. The most critical issue was the network failure when testing the functionalities. It was overcome by a proper WI-FI connectivity. And also, the IP addresses were changed when the system has turned on in each time before the team has hosted it in a server. The team has faced many challenges when developing the system such as to find a two-way mirror in Sri Lanka. Therefore, team has ordered it from e bay to overcome it. The development of the mirror could have much easy if the screen of the mirror is touch screen one.

The Reliability of the system depends on the accuracy rate of the system. According to the test cases done, the main functionalities worked properly. There were only few defects found when testing the functionalities. But the team has managed to solve the defects up to some level. In the final evaluation the accuracy rate of the system is about 90 % and the 10% is rely on the network signal strength.

V. CONCLUSION AND FUTURE WORK

It is a universally accepted truth that raising a child is an extremely responsible task. One of the major problems faced by parents/guardians nowadays is monitoring their children while they are away at work. The Raspbian Magic Mirror system provided comprehensive solution to the working parents. The Smart mirror which is fully functional predicting system for parents, to remind/encourage (to-do-list) their children in studies and extracurricular activities and get them to work by sending notification. The accomplished work will be verify by sending a voice note through the mirror to their parents. The smart mirror will display addition details such as weather, time, date, calendar with updates. Developing a mobile application to control the mirror. The team uses Raspberry Pi technology, to implement a mirror with the intention of enable an efficient parenting. Finally, the project successfully achieved to fulfil all the objectives of this system and hope this research would be of benefit. The research team hopes that this study will be helpful for the researchers who are interested in the topics like children monitoring system, tracking system as well as systems that are related to IOT. It will also give better ideas and more knowledge to implement similar kind of projects.

During the development of this project, the following are the limitations identified:

- To use the system users must have an Android mobile phone with the application installed.

- If the Internet connection is down, the system won't be able to continue the connectivity and the data won't be stored in the database.

- Data transaction may disconnect when the server goes down.

- Because of the internet problem, the data transaction from the mobile application to the database and database to the mirror may get slow.

This paper proposed a real world Raspbian Magic Mirror scheme which is implementing in existing by the research team. In future, researchers with related area of interest can deploy the proposed scheme and carryout addition performance such as procedure the system with the other language. Applying to real world context will lead to accurate scalability in accurate parenting analyzing Raspbian Magic Mirror.

REFERENCES

[1] Jose, Jane et al. "Home Automated Smart Mirror As An Internet Of Things (IoT) Implementation". IJARCCE Vol. 6.Issue 2 (2017)

[2] Jadhav, Gaurav, Kunal Jadhav, and Kavita Nadlamani. "Environment Monitoring System Using Raspberry-Pi". International Research Journal of Engineering and Technology (IRJET) Volume: 03.Issue: 04 (2016)

[3] Biswas, Mendrela et al. "Raspberry Pi Based Patient Monitoring System Using Wireless Sensor Nodes". International Research Journal of Engineering and Technology (IRJET) Volume: 03.Issue: 04 (2016)

[4] Dr. V.Ramya., and G. Thirumalai Rajan. "Raspberry Pi Based Energy Efficient Industrial Automation System". International Journal of Innovative Research in Computer Science and Engineering (IJIRCSE) Volume: 02.Issue: 01 (2016)

[5] Liyana Zahari, Zarith, Azliza Mohamad Arshad, and Saidatul Najihah Abdul Ghani. "An Implementation Of Raspberry Pi On Children Tracker Application". International Journal of Applied Engineering Research Volume 11.Number 6 (2016)

[6] Mahindrakar, Smita, and Ravi K Biradar. "Internet Of Things: Smart Home Automation System Using Raspberry Pi". *International Journal of Science and Research (IJSR)* 6.1 (2015): 2. Print.

[7] Deshpande, Aniket, and Anil Wanare. "Design And Implementation Of TCP/IP Web Server on Raspberry Pi". *International Journal of Science, Engineering and Technology Research (IJSETR)* 4.12 (2015): 1. Print.

[8] Ali, Fuead, and Noor Azhar Amran. "DEVELOPMENT OF AN EGG INCUBATOR USING RASPBERRY PI FOR PRECISION FARMING". *International Journal of Agriculture, Forestry and Plantation* 2.2462-1757

[9] Jagadish Nikharge, Bhagyashree et al. "SMART HELMET - INTELLIGENT SAFETY FOR MOTORCYCLIST USING RASPBERRY PI AND OPEN CV". International Research Journal of Engineering and Technology (IRJET) Volume: 03.Issue: 03 (2016)

[10] Laccase, Fabio, and Marco Cagnetti. "An Intelligent And High Efficiency Street Lighting System Isle Based On Raspberry-Pi Card, Zigbee Sensor Network And Photovoltaic Energy". *International Journal of Engineering Science and Innovative Technology (IJESIT)* 3.6 (2014)

[11] ANITHA, T., and T. UPPALAIAH. "Android Based Home Automation Using Raspberry Pi". International Journal of Innovative Technology Vol.04.Issue.01 (2016)

AUTHORS

First Author – R.M.B.N. Siripala
Faculty of Computing, Sri Lanka Institute of Information Technology, Colombo, Sri Lanka.
E-mail: nimalibuddhi@gmail.com

Second Author – M. Nirosha.
 Faculty of Computing, Sri Lanka Institute of Information Technology, Colombo, Sri Lanka.
E-mail: niroshamini@gmail.com

Third Author – P.A.D.A. Jayaweera
Faculty of Computing, Sri Lanka Institute of Information Technology, Colombo, Sri Lanka.
Email: dilu.anurada@gmail.com

Fourth Author- N.D.A.S. Dananjaya
Faculty of Computing, Sri Lanka Institute of Information Technology, Colombo, Sri Lanka.
E-mail: zoolodanapop@gmail.com

Fifth Author-
S.G.S. Fernando,
Senior Lecturer
Faculty of Computing, Sri Lanka Institute of Information Technology, Colombo, Sri Lanka.
E-mail: gayana.f@sliit.lk