

Name: K.C. Berenger

Student Reference Number: 10673083

Module Code: PUSL3108	Module Name: Pervasive Computing
Coursework Title: Pervasive Computing Coursework	
Deadline Date: 11/05/2021	Member of staff responsible for coursework: Mr. Craig Banyard
Programme: BSc (Hons) Software Engineering	
Please note that University Academic Regulations are available under Rules and Regulations on the University website www.plymouth.ac.uk/studenthandbook .	
<p>Group work: please list all names of all participants formally associated with this work and state whether the work was undertaken alone or as part of a team. Please note you may be required to identify individual responsibility for component parts.</p> <p>10673076 - P.G.G.M.B. Bandara 10673083 - K.C. Berenger 10673116 - I.A. Dissanayake 10673118 - M.D. Dissanayake 10673123 - S.S.D.H. Fernando 10673260 - M.A.O.G. Kithmina</p> <p><i>We confirm that we have read and understood the Plymouth University regulations relating to Assessment Offences and that we are aware of the possible penalties for any breach of these regulations. We confirm that this is the independent work of the group.</i></p> <p>Signed on behalf of the group: K.C. Berenger</p>	
<p>Individual assignment: <i>I confirm that I have read and understood the Plymouth University regulations relating to Assessment Offences and that I am aware of the possible penalties for any breach of these regulations. I confirm that this is my own independent work.</i></p> <p>Signed _____</p>	
<p>Use of translation software: failure to declare that translation software or a similar writing aid has been used will be treated as an assessment offence.</p> <p>I *have used/not used translation software.</p> <p>If used, please state name of software.....</p>	
<p>Overall mark _____% Assessors Initials _____ Date _____</p>	

Table of Contents

1. PART A.....	3
1.1. FITBIT	3
1.1.1. Discussion	4
1.2. Amazon Alexa	5
1.2.1. Discussion	6
2. PART B	8
2.1. AUTOMATED BUS CROWD MANAGEMENT SYSTEM	8
2.2. Features of the system	10
2.3. Requirements	11
2.3.1. Hardware	11
2.3.2. Software	11
2.4. Circuit diagram of the system	11
3. References	12

Name	Student ID	Contribution
1. P.G.G.M.B.Bandara	10673076	16.7%
2. K.C.Berenger	10673083	16.7%
3. I.A.Dissanayake	10673116	16.7%
4. M.D.Dissanayake	10673118	16.7%
5. S.S.D.H.Fernando	10673123	16.7%
6. M.A.O.G.Kithmina	10673260	16.7%

1. PART A

1.1. FITBIT



Source: Keleigh Berenger's Fitbit Watch

A Smartwatch is basically a wearable computer in the form of a watch. It is a hybrid of a watch and a smartphone. It is capable of telling time just as a normal watch, but also it has touch screens, supports applications and records heart rate and other vital signs.

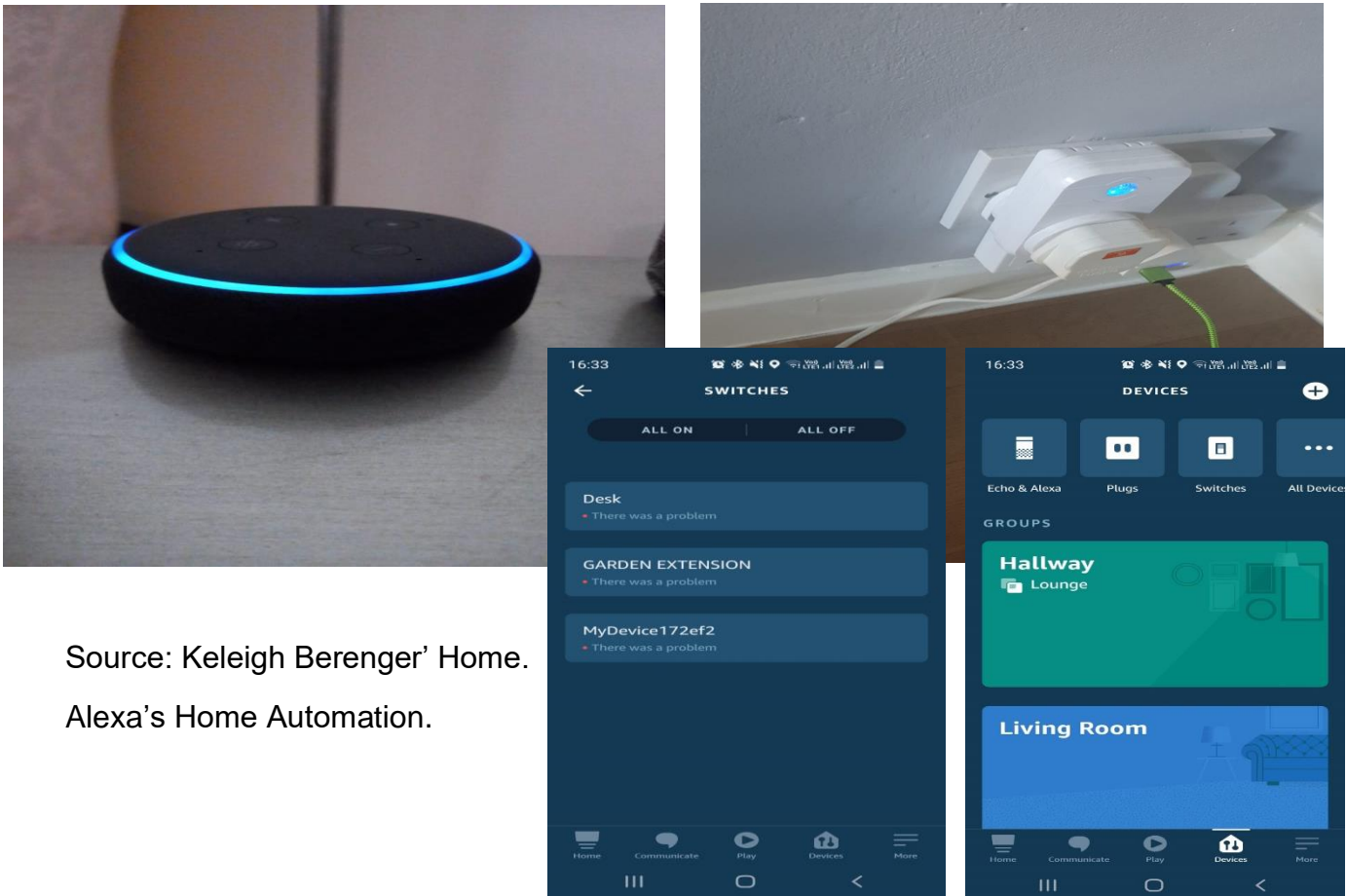
"Fitbit", which is an activity monitoring and a wearable technology, is a great example for a smartwatch. It has the capacity to measure data like, heart rate, quality of sleep, steps climbed and other basis for personal fitness. (Whitson C. , 2018)

1.1.1. Discussion

- "Fitbit" holds an essential piece in the healthcare ecosystem. It recently purchased Twine Health and partnered with Google Cloud. This added the system with some more unique features like real time medical information, remote medical assistance, preventative care, and personalized machine learning to keep people healthier and detect any illness before it advances beyond a manageable level. It also provided consumers with more information and professional care as a solution to the problem especially within older population, where nearly 90% of individuals over the age of 65 visit their doctor at least twice a year and less than 5% use wearable trackers. Therefore, with this added feature, there is no need to physically go anywhere. (Mainwaring, 2019). Fitbit also has a silent alarm feature which allows you to wake up peacefully, because of the pleasant vibration it gives on your wrist rather than a loud siren (Ktischner, 2016). Fitbit connects to many other different fitness apps like MyFitnessPal, Runkeeper, Endomondo, Loseit, MapMyRun and Weight Watchers and etc. which gives you the opportunity to get an overall picture of your health and fitness goals. (Wynja A. , 2021)
- Fitbit has issues regarding its accuracy. According to what is claimed, all Fitbit trackers should be 95-97% accurate for step counting when worn. But sometimes it does not track the full number of steps you have taken. As an example, when pushing a cart, your wrist is not moving, and the Fitbit has difficulty recognizing that you are stepping. This is a major issue with the device. (Ktischner, 2016) Fitbit also has issues in giving out inaccurate heart rate and calories burned. Some customers believe that Fitbit overestimates their activities and how many calories that they should be consuming. (Wynja A. , 2021) (Ktischner, 2016). It has more quality control issues, where in 2016, Fitbit was sued over alleged accuracy issues regarding its PurePulse heart tracking technology.
- Fitbit is useful because it tracks almost everything to do with your fitness and health. It can track how many steps you take in a day, how many miles you walk or run. The calories and food you eat, and even your blood pressure can be measured with this. Fitbit also helps track your sleep, which is a very important part of your health. It tracks your sleep patterns and hours spent sleeping. If you are not sleeping enough or are getting very restless, you can find ways to improve your sleep with the help of Fitbit. People also consider Fitbit to be a great motivator because you can set a goal on the device for the day, and you are determined to go about your day until you have reached it (Ktischner, 2016). Fitbit has different varieties ideal for different needs like waterproof varieties, clip-on design etc. (Whitson C. , 2018)

- Battery life of Fitbit is affected by its use and other settings. Normal battery life of Fitbit smartwatch is 6+ days, but it varies with the use. Use of the always-on display and GPS features require more frequent charging. They recommend customers to use the charging cable that comes with the device. But after several hundred charge cycles, the device may need to charge more often. As an improvement, the device could be charged to 100%, then turn off the device to avoid additional battery use. Also do not leave the device plugged in on the charging cable during storage.
- Fitbit does not send reminders. It can go through meaningful Fitbit OS improvements, where it would deliver more reliable notifications and reminders, better shortcuts, always-on display and more.

1.2. Amazon Alexa



Source: Keleigh Berenger' Home.
Alexa's Home Automation.

Developed by Amazon, Alexa is a virtual assistant A.I (Artificial Intelligence), that competes with Google Assistant and Apple's Siri. At present Alexa is the rage as it is available on various devices including smart phones, smart speakers and smart displays. Alexa is a prime example of AI and machine learning in action. Systems such as Alexa shows a massive shift in how machine interaction is done. (Vigliarola, 2020)

1.2.1. Discussion

- Alexa performs a number of preset functions that are out of the box, which makes it a unique system, by listening to commands ensued after the wake-word alerts it. Most devices with Alexa allow users to activate services by using a wake-word (such as 'Alexa' or 'Amazon'). You do not need to use your hands while making commands on Alexa enabled devices. (Ratnesh, 2018)
When questions are asked, Alexa converts the sound waves into text allowing information extraction from many sources including Yelp, Wikipedia, iMDB, Wolfram Alpha etc. Alexa's voice capabilities can also be integrated to connected products by using the Alexa Voice Services (AVS), a cloud-based service that provides APIs to interface with Alexa. AVS provides cloud-based automatic speech recognition (ASR) and Natural Language Understanding (NLU). Alexa can also use itself as a home automation system by controlling several smart devices. Also, it can interact with many manufacturers, including Sonos, Fibaro, SmartThings, Belkin, IFTTT, LIFX, Nest, Wink etc. Developers can also create their own smart home using the Alexa Skills Set. A 'Smart Home Skill App' is meant to get this function working and most of the code is run entirely on the cloud using Amazon's AWS Lambda Service. Alexa is also compatible with sensors. Samsung SmartThings Motion Sensor is one of the few Alexa compatible sensors, because of its long-range coverage. A connected Alexa companion App allows you to monitor and maintain functions. It also allows you to find devices that are compatible by simply saying the words 'Alexa, discover devices.' (Reisinger, 2016) One of Alexa's newest skills is that the ability to work as an intercom system. By naming and placing each Echo device and enabling drop-in functionality on the Alexa App. (Bonnington, 2021)
- There are several shortcomings that can be seen in the Alexa system. One of the main issues that the system has is that it does not work on battery power. It must be plugged into the power all the time. Also, Amazon keeps a copy of everything Alexa records after it hears its name. Others can access Echo conversations and the privacy rights are signed away at purchase. Any personal data that is collected can and will be used against the owner. (Geoffrey.A.Fowler, 2019)

There have been issues regarding Amazon's voice assistance not getting activated when the second "a" is not low and loud enough. This confuses Alexa. Alexa can be confused with "Alex", which is one of the most popular names in the world. So far, you only can choose between "Alexa," "Amazon," "Echo," and "Computer." These words are too common, and Alexa can be woken up every time you say, "a parcel from Amazon has arrived." (Kowalczyk P. , 2018)

People also can identify who is present based on Echo private conversation. (Ratnesh, 2018)

Alexa takes several days to update to a new version. It is based on the cloud so there can be troubles if any problems in the cloud. Alexa can be temperamental. There can be sudden outages. For example, when reading a book, the speaker fails sometimes. (Brandon, 2016)

- Alexa as a system, is very useful. The service that Alexa along with its Amazon Echo Smart Speaker offers, varies from voice interaction, streaming podcasts, make to-do-lists, alarms to provide real time information such as news, weather, traffic, sports etc. With the help of Alexa home automation system, different sources detect activity – motion, temperature, and Alexa tells how other devices should react. (Tuohy, 2020)

Also, it is the major smart home platform for controlling lights, doors (a door/window opening and closing), locks etc.

Alexa supported devices can also stream in music from users Amazon account and have built in support for Pandora and Spotify accounts. Alexa also allows a paid subscription service known as 'Alexa for Business' allowing companies to use Alexa for conference calls, scheduled meeting rooms etc. Notable skills are made available from SAP, Microsoft, and Salesforce. Alexa understands natural language and processes it efficiently and acts as a model for chatbots. Alexa is highly extensible and saves time and improves your day. (Brandon, 2016)

Alexa can also rate and give you the best choices for any decision making. (Ratnesh, 2018)

- As mentioned in the problems that the system has, Alexa keeps a record of what it hears every time an Echo speaker activates. It is supposed to record only with a "wake word" — "Alexa!" — but anyone with one of these devices knows they go rogue. There can be sensitive personal data that can be used against people. Amazon says it has improved the accuracy of "Alexa" as a wake word by 50 percent over the past year. But as an improvement, more options for wake words can be introduced to the system, where the system can be personalized with different wake words introduced by only the owner who uses it. That way security of the system will be high. (Geoffrey.A.Fowler, 2019)
- The system is still English-centric. After four years only, it introduces three languages: English, German and Japanese. "Three more: French, Spanish, and

Italian are available for developers of Alexa Skills “ (Kowalczyk P. , 2018). Compared to other available systems, this is well behind competitors when it comes to reaching international customers. Alexa should introduce more languages as an improvement to the system. To communicate with the voice assistance, you need a few hundreds of words.

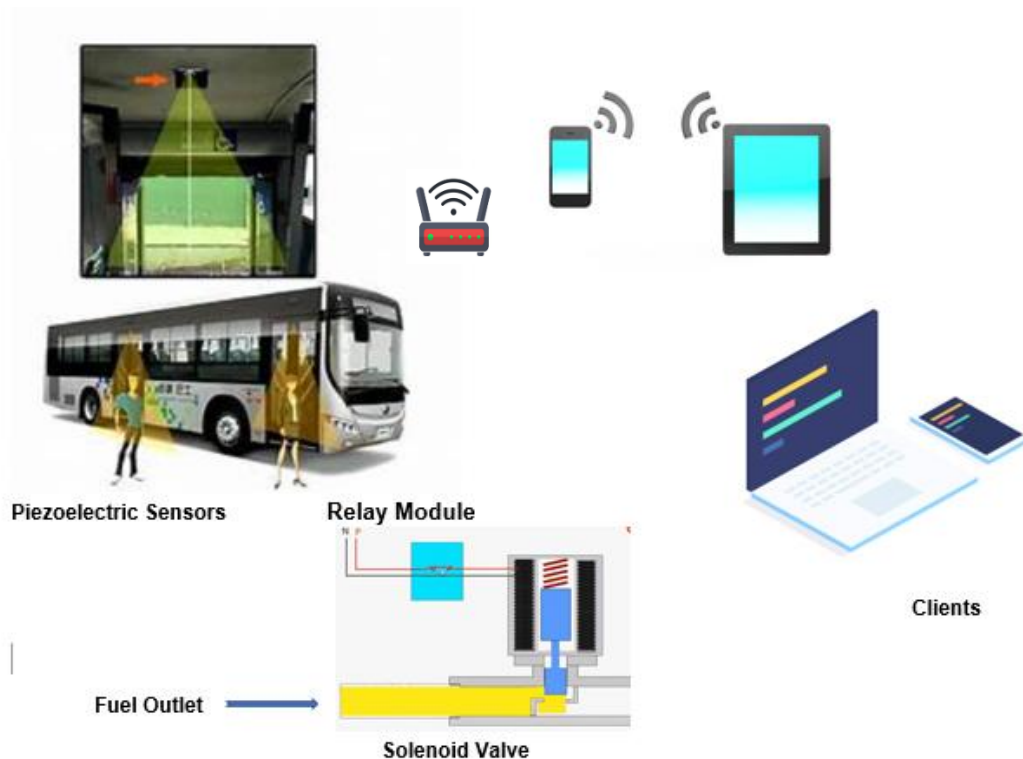
2. PART B

2.1. AUTOMATED BUS CROWD MANAGEMENT SYSTEM

Following up on a number of road accidents it is clear that Sri Lanka holds one of the highest records in the world, when on average, there are more than 3000 road accidents reported annually (SOMASUNDARASWARAN, 2020). When we consider the public transport in Sri Lanka, we see that buses are almost always prone to danger. One of the many reasons for this is over-crowding.

With the rise of the COVID'19 virus for the first-time regulations were issued for crowd controlling in buses. According to 'travelban.org' the maximum number of passengers that could board a bus was brought down to 15. But like how they say “words are just words”, Sri Lanka's bus drivers have a nasty habit of not heeding the rules. The authorities cannot keep track and up to date, have no efficient system for monitoring and controlling crowds in buses. They would pick one bus out of many and physically go into the bus to monitor the situation. This method results in a lot of time wasted, many buses not monitored, rules broken and lives in danger.

As a solution to the above described problem, our team has designed, a bus crowd management system which would monitor the number of passengers that get in and out of the bus, putting a restriction on the bus engine if the limit of passengers boarded, exceeds a target number. This way we can also control disobedient bus drivers and report their disobedience to the relevant parties.



Starting off with front end detection, we would use two Piezoelectric infrared sensors, mounted on either side of the door. One sensor would be used to detect people boarding in and the other for the off. Here the readings taken from the Piezoelectric Infrared sensors would act as the input and the software system compiled with the micro controller, would send data as messages to a GSM (Global System for Mobile communication) modem, if passenger target number is crossed. The GSM modem would then transmit the messages to the respective parties and to a central database which would store any information in respect to the parties and bus as mentioned. (Tamir, 2017) When the count of the passenger numbers depicted by the ECU (Electronic Control Unit) reaches over target limit it would give a reading to ARDUINO.

When it comes to fuel, a bus would run on either diesel or petrol and in turn, the mechanism in which the battery functions is different. But the method to which we can control the engine, using a relay module is the same. In a bus the usual battery voltage is 24V. The negative points of the battery is grounded and the positive points run through a fuse box which controls lights, sound or other power consuming object connected. In this case the ignition switch is one of those that is connected. Once the ignition switch is on and the relay module is activated on a point of fuel distribution, the fuel shutoff valve (In Diesel powered buses, this is known as the solenoid valve) would open thus starting and running the engine. (Dada Emmanuel Gbenga, 2017) In the case of the sensors, sending a signal to the ARDUINO board to deactivate the relay module, the fuel shutoff valve would close, severing the fuel line and shutting the engine down.

To restart the engine there will be an embedded code that would collect an input from the Piezoelectric infrared sensors. In this case if the sensor picks up that a passenger has left and the count drops below target limit the code to restart the engine will function.

2.2. Features of the system

- The Piezoelectric infrared sensors used for this system can detect both passenger boarding in and passenger boarding out separately distributing detection functions. Regardless of what clothing a passenger may wear the Piezoelectric infrared sensor would easily detect infrared emitted from the body making detection more reliable. (Shanzhen Xu)
- If the number of passengers reaches above target limits, the relevant authorities and the head of the depot to which the bus belongs to, would get a message and information of the bus (Bus Plate No, Current Driver, Current Location etc.), to take action. (Tamir, 2017)
- A buzzer which would function as the alarm unit in the bus and would activate upon an oscillating signal, passing through the coil of the buzzer, fluctuating the disk in the buzzer. This would sound an alarm to the driver in front that the passenger limit has been reached. (Dr. Pavan Shukla, 2020)
- The input received from the sensors mounted on the doors would also be the input taken to control the vehicle engine. But there is a risk of the engine coming to a stop when in motion. It could be a faulty reading from the sensors or the driver's disobedience, but if the bus were to stop while on the road, that could lead to a huge accident. For this purpose, a motion detector on the engine would send a signal (1 – in motion or 0 - halted) to the Arduino board, when a signal to deactivate the relay module is sent by the piezoelectric infrared sensors. A code embedded would then give instruction for the bus to not come to a stop, if in motion but instead the alarm would sound and the GSM Modem would function the same as stated before. (Pratiksha Bhuta, 2015)
- The following system would also provide a facility to the driver to choose an option of acknowledging the overload and fixing it by physically seeing to the passenger count. This option will pop up with a warning notification to the driver's mobile phone or to an inbuilt display in the bus if there were to be one.

2.3. Requirements

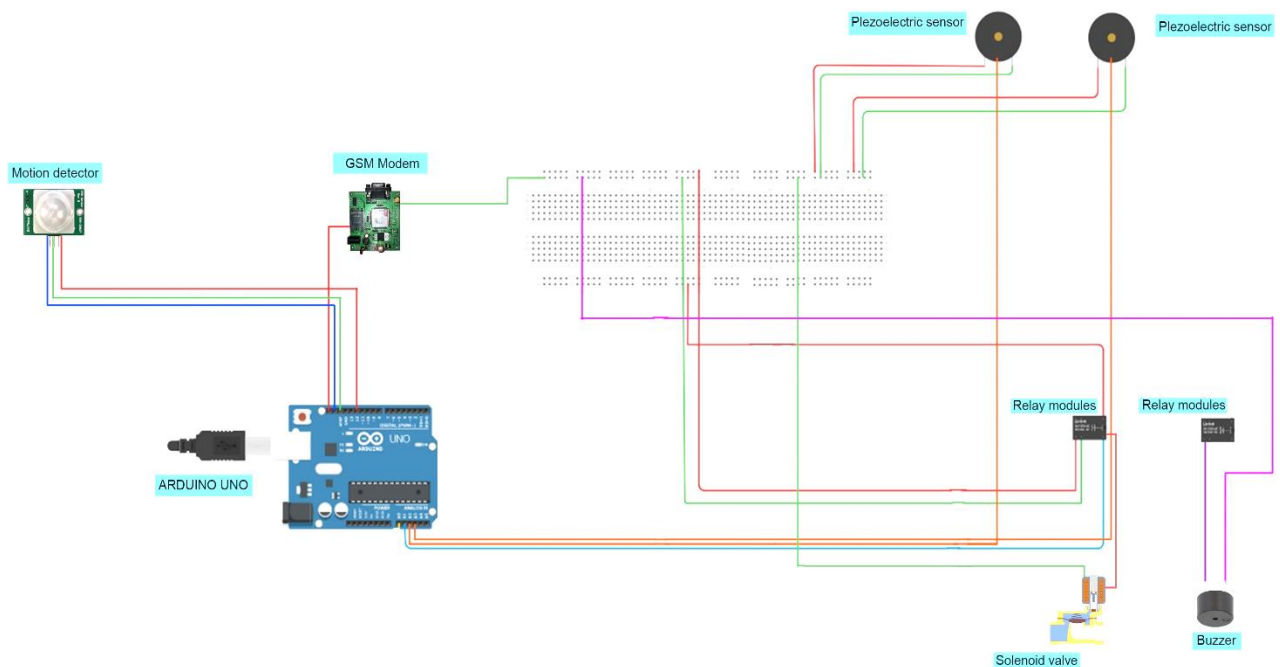
2.3.1. Hardware

- Two Piezoelectric infrared sensors
- GSM modem
- A buzzer
- Relay module
- Motion Detector

2.3.2. Software

- ARDUINO compiler
- MC programming language

2.4. Circuit diagram of the system



- We would also provide in manual override to authorities on how to restart the engine if there were to be a case in which the transporting of passengers has come to a halt.

3. References

- Bonnington, C. (2021). *Make house-wide announcements with Amazon Alexa Intercom Systems*.
- Brandon, J. (2016). *The Pros and Cons of using Amazon Alexa as a model for chatbots*.
- Dada Emmanuel Gbenga, H. I. (2017). Alcohol Detection of Drunk Drivers with Automatic Car Engine Locking System. Available from: <https://www.semanticscholar.org/paper/Alcohol-Detection-of-Drunk-Drivers-with-Automatic-Gbenga-Hamed/c1df7d78db6ec6493cc9f8ff3b178df6bede98e8>
- Dr. Pavan Shukla, U. S. (2020). Automatic Engine Locking System Through Alcohol Detection. Available from: <https://www.ijert.org/automatic-engine-locking-system-through-alcohol-detection>
- Geoffrey.A.Fowler. (2019). *Alexa has been eavesdropping on you this whole time*.
- Kowalczyk. (2018). *8 THINGS AMAZON SHOULD IMPROVE IN ALEXA*.
- Ktischner. (2016). *Pros and Cons of a Fitbit: Helpful or Just Hype?* Elon Contributor. Available from: <https://www.hercampus.com/school/elon/pros-and-cons-fitbit-helpful-or-just-hype>
- Mainwaring, S. (2019). *Purpose At Work: How Fitbit's Giveback Is Strengthening Its Business*. Available from: <https://www.forbes.com/sites/simonmainwaring/2019/02/12/purpose-at-work-how-fitbits-giveback-is-strengthening-its-business/?sh=1aae494858d2>
- Pratiksha Bhuta, K. D. (2015). Alcohol Detection and Vehicle Controlling. Available from: <http://www.ijetajournal.org/volume-2/issue-2/IJETA-V2I2P14.pdf>
- Ratnesh. (2018). *Amazon Alexa - Props, Cons and competitors*.
- Reisinger, D. (2016). *Who (or what) is Alexa? We explain Amazon's Digital Assistant*.
- Shanzhen Xu, Q. Z. (n.d.). Study on Vehicle-mounted Overloading Control System for Passenger Vehicles. 2011. Available from: <https://www.sciencedirect.com/science/article/pii/S1877705811017255>
- SOMASUNDARASWARAN, A. (2020). *SL ACCIDENT STATISTICS IN SRI LANKA*.
- Tamir, T. S. (2017). Designing Of Overload Monitoring System In Public Transportation Based On Microcontroller in Ethiopia. Available from: https://www.researchgate.net/publication/340717933_Designing_Of_Overload_Monitoring_System_In_Public_Transportation_Based_On_Microcontroller_in_Ethiopia
- Tuohy, J. P. (2020). *The best smart home sensors for Alexa*.
- Vigliarola, B. (2020). *Amazon Alexa : Cheat Sheet*.
- Whitson, C. (2018). *Fitbits and Smartwatches: Advantages and Disadvantages*. Health Care News. Available from: <http://www.connectionstrc.org/fitbits-and-smartwatches-advantages-and-disadvantages/>

Wynja, A. (2021). *Pros and Cons of Fitbit, a Trainer's Perspective*. Available from:
<https://www.fitismed.com/blog/2015/4/21/pros-and-cons-of-fitbit-an-exercise-physiologists-perspective>

Teschler, L. (2016). Teardown: Inside the Fitbit Charge. Available from:
<https://www.microcontrollertips.com/inside-fitbit-charge/>