SMART CITY IS SMART SOLUTION FOR CITY DEVELOPMENT IN GLOBAL ERA

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ABSTRACT

The industrial revolution 4.0 brought many changes in society, especiallyin the implementation of Internet of Things (IoT) devices. The presence of IoT devicescan improve the quality of human life, processes in business, and governance. This study aims to analyze the implementation of IoT in various types of market segments,ranging from the Business to Consumer (B2C), Business to Business (B2B), and Business to Government (B2G) markets. From the results of the study, it is known thatthe implementation of IoT has been widely applied and is able to provide various benefits, ranging from long-term efficiency, energy efficiency, improving the quality of activities at home, and various other benefits. There are many challenges in IoT implementation, ranging from large investment value, imperfect infrastructure, to risksrelated to data security and security devices. It also includes its role in building sustainable smart cities that are environmentally friendly as well as technological innovation and entrepreneurship

Keywords: Internet of Things, smart city, innovation, entrepreneurship, sustainability

1. INTRODUCTION

Internet of Things (IoT) is a new paradigm that allows human activities to be supported and transformed using connected devices into an integrated system, so that ultimately it can shortenthe time needed to carry out transactions in these activities. The emerging of IoT implementation in industry 4.0 can be seen from the rapid adoption of smart home devices, smart city, IoT devices embedded in fleet, disaster control devices, smart industries, and manyother transformations in the industries. IoT usually use devices which connected to integrated systems which utilized connectivity, cloud computing, data center, and other IT Infrastructure.The rapid implementation of IoT driven by the needs of market to record their activities in systematic way in order to generated insight automatically which usually need to be manually recorded by human. For example, IoT devices such as building sensor may be used to count how many humans entered the building (Kumar, 2019) (Miller *et.al*., 2015).

In the Covid-19 pandemic era, IoT devices such as smart temperature sensor can be used to detect human body temperature, and in the end building management can see the average of human temperature which entered the building. In agriculture, IoT such as drone can be used to analyze the size of the farm and the farmer can gain the big picture of the farm landscape andthe potential of rise in certain landscape. IoT devices slowly become the part of human daily lives and may be seen everywhere around the society (Al-Obaidi, 2022).

In business to consumer market, IoT devices can be purchased in the form of smart home appliances. Smart CCTV, smart lock, smart lamp, smart pet feeder are the examples of IoT smart home appliances which can be purchased from e-commerce to enhance security, as homedecorations, in short to improve the quality of activities at home. Therefore, IoT can be implemented in B2C (Business to Consumer), B2B (Business to Business), and B2G (Business to Government) market (Domb,2019) (Chawda, 2020).

Although, the implementation of IoT can be beneficial for daily human activities there are somechallenges involving the implementation of IoT in larger scale. First of all is the cost of investment, IoT devices for smart city program need to be purchased in large scale, therefore the government need to allocate specific budget for this digital transformation (Kumar, 2019). There may be some challenges in the bureaucracy because not all high-level officer who in charge of the budget, aware the benefits of IoT implementation. The next issue is about network infrastructure. In order to optimize IoT devices to working properly, the devices need to be supported with high speed and low latency connectivity. In big city where fiber optic infrastructure already exists property, this may not be common problem, but it will be differentwhen the implementation is on rural site/area (Prihantoro, 2020).

2. LITERATURE REVIEW

The IoT market can be considered as one of promising businesses in the years to come. Basedon research from Global Newswire, the market is anticipated to rise from USD 478.36 billion in 2022 to USD 2,465.26 billion by 2029 with CAGR of 26.4% [7]. Various projects of IoT already taken the market in the recent years, the figure can be seen from

diagram below:

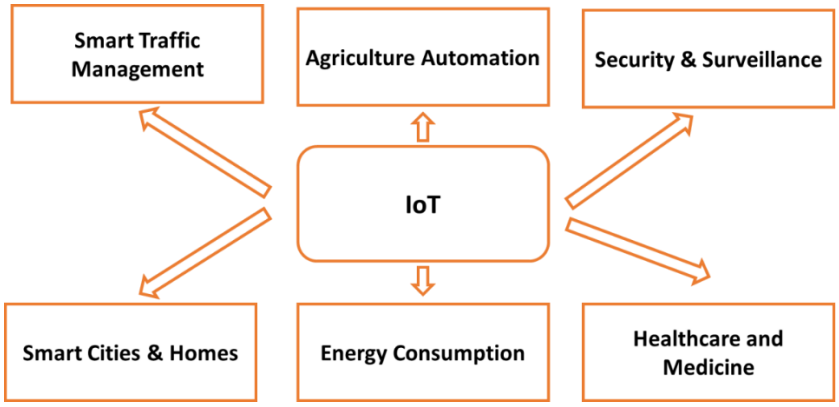

Figure 1. Main IoT Project

There are six main projects around the world involving IoT in as the core of digital transformation. For the Smart Traffic Management, Indonesia National Police already has implemented Electronic Traffic Law Enforcement (ETLE) to monitor the traffic and to givingpenalty when someone disobey the traffic law. ETLE used smart camera to detect the car/motorbike number, and then give the penalty letter directly to the home of the owner. For the agriculture automation, Smart farming technology allows farmers to have better control over the process of growing crops and raising livestock. In this way it can lead to large-scale efficiencies, cut costs, and help in saving scarce resources, such as water. Farmers can reduce waste and increase productivity which ranges from the amount of fertilizer used (Kumar, 2019) (Miller *et.al*., 2022).

For the security and surveillance, IoT devices such as Smart CCTV & Smart Lock which has quite a high demand in the B2C market. Since a fixed sum of money must be paid to an administration provider to store the recorded video even though no human activity is seen, thepresent security systems against robbery are quite expensive. An intelligent surveillance systemthat starts recording video only when a person move is the answer to this issue. In the end, this reduces the amount of storage space needed and lowers the cost of the system. The system is turned on by the user while they are exiting the building. The system's operation begins with motion detection, which is then refined to human detection, followed by a count of the numberof people in the space and an alarm that alerts the neighbor to the presence of people. Additionally, the user receives email and SMS notifications regarding to the recording (Chawda, 2020)

In Covid-19 pandemic, the use of IoT to minimize human contact between patient can be seenas the future of healthcare business. The most widely used use of IoT technology in healthcareis remote patient monitoring. Patients who are not physically present at a healthcare facility canhave their heart rate, blood pressure, temperature, and other health metrics automatically collected by IoT devices, doing away with the need for them to visit their clinicians or gather the information themselves. When an IoT device gathers patient information, it sends the information to a software program so that patients and/or healthcare providers can examine it. To prescribe treatments or produce alarms, algorithms may be employed to examine the data. For instance, a patient's exceptionally low heart rate could be detected by an IoT sensor, whichcould then send out an alert so that medical personnel can act (Khamitkar, 2020). The process of IoT sensors for heart rate can be seen from figure below:

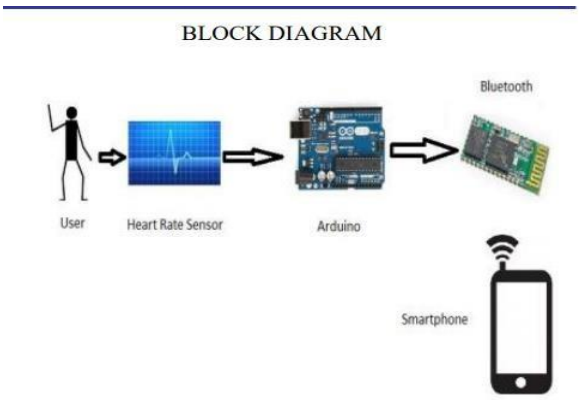

Figure 2. IoT Heartbeat Rate Architecture

To minimize the cost from building energy consumption, applications of the Internet of Things(IoT) are quickly implemented in smart buildings to reduce energy consumption. One of the most common examples is by using sensor in the room to cut the light power off when there are no one in the room. With this method, building management can cut the overall cost consumption from lighting usage. Other IoT example for saving energy is by using solar water heating (SWH) system. Several sensors were used including solar irradiance sensor, flow meter,temperature sensor, status sensor, and electricity meter, and can be found by using SWH, the electricity can be saved up to 32.9% (Al-Obaidi, 2022). The architecture of SWH can be seen from figure below:

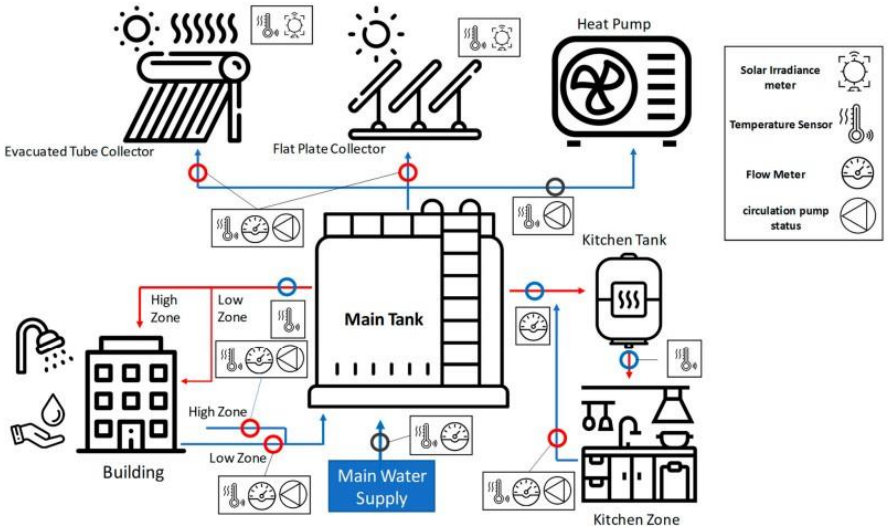

Figure 3. IoT Solar Water Heating Architecture

The government's smart city program was begun to be promoted in 2021 in Indonesia, many strategic collaborations have begun to be built between system integrators and district and citygovernments. Generally, the implementation at the beginning was widely planned for securityneeds, such as the implementation of CCTV at every street corner which can be integrated withthe relevant city mobile application. In addition to these general needs, the application of IoT for disaster management needs is one of the most popular things that attracts attention. One example of collaboration between system integrators and the government related to disaster management systems is the collaboration between the DKI Jakarta provincial government andXL Axiata for the application of IoT flood management (Gulve, 2017).

Smart home technology is one of the most popular IoT adoption for business to consumer market. Smart home is the basically an extension for home automation and involves the controland automation of all its embedded technology. The appliances can be used for lighting system,water heating, smart air conditioning, TVs, computers, entertainment systems, big home appliances such as washers/dryers and refrigerators/freezers, security camera which capable of communicating with each other and can be controlled remotely by phone via internet. These systems consist of switches and sensors connected to central hub in cloud system (Chawda, 2020)

Automation by IoT devices provides various advantages that cannot be obtained by business processes that are carried out manually. IoT devices are considered more reliable, have a bettersecurity & safety system, and produce better efficiency. These advantages can be achieved through the ability of IoT to be able to connect to heterogeneous devices, accurately track location, manage information, optimize energy use, which can be controlled via smart home devices (Chawda, 2020).

Iot devices in their implementation face various challenges that hinder optimizing the use of devices, some of the challenges are that there is no urgency to invest in IoT devices because theprocess can be done manually even though it is not cost effective in the long term, in addition,supporting components are needed to be able to operate IoT devices such as connectivity & cloud storage, so that if these supporting components are not available, the IoT devices cannot run optimally. In addition, interoperability of cross-brand IoT devices is still difficult to do, because each manufacturer provides devices with special software only to control devices withthat brand (Kumar, 2019)

Another challenge from the government and enterprise segments can be seen from the lack of optimal awareness from stakeholders related to the implementation of IoT devices. Currently only IoT such as smart CCTV, Smart Lamp, and several other devices are devices that are pioneers in implementing smart city programs. In addition, from the enterprise side, IoT is generally embedded in premium office building facilities, in the logistics industry IoT is applied in the form of a mobile tracker in the fleet management system, in the manufacturing sector it can be seen from Intelligent Energy Management Systems devices to save costs (Domb, 2020). Lawal K and Rafsanjani H N (2022) said that the IoT component can be categorized into the following 3 components:

a. Hardware: This component is hardware that can consist of intelligent sensors, communication hardware, and actuators embedded in the building to enable remote monitoring & control. This hardware serves the task of connecting physical devices with thedigital aspects of IoT to obtain information related to the IoT environment.
b. Middleware: this component consists of software such as databases, servers, protocols, andqueries to send and receive information from devices. This aspect generally consists of a cloud computing layer and a wireless communication layer whose task is to collect data fromsensors, analyze it and store the data. Middleware filters out unwanted information, which then proceeds to send data to the associated cloud.
c. Presentation: This IoT section represents the service layer consisting of visualization components and implementation tools, allowing users to monitor and control their IoT systems. Currently, most applications are formed using two types of platforms, both web- based and mobile-based applications.

3. METHODOLOGY

This study was conducted by using literature review method by using secondary data as mainsource. The flow of the study can be seen in the following:

a. Gathering resources from existing literature, mainly from online journals, books, andinternet websites.
b. Analyze the sources which has been gathered.
c. Identify the information, to assess its relevancy to the topics.
d. Summarize key points of each relevant source by using technology lifecycle framework.
e. Conclude the Research.

4. RESULT AND DISCUSSION

This section will further analyze related to the implementation of IoT products which will be divided into 3 main market segments, namely Business to Consumer, Business to Business, and Business to Government.

Business to Consumer (B2C)

IoT applications in the business to consumer segment are quite dominated by smart home devices. Currently, with the development of the e-commerce industry, smart home devicesare becoming easier to be accessed by consumers [5].

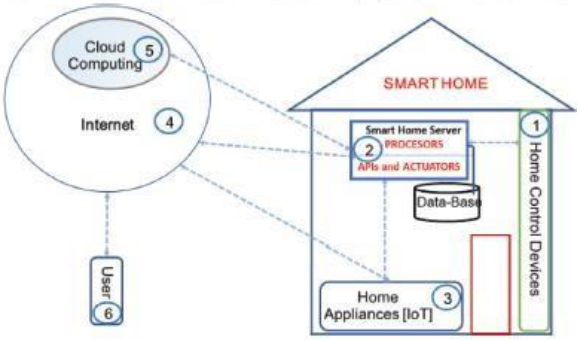

Figure 4. IoT Smart Home Architecture

In terms of smart home architecture, there are 6 main points of this architecture starting from home control devices that function to control IoT devices, then processed on the smarthome server, the request data will be submitted to home appliances / IoT devices, IoT devices connected to the internet which is connected directly to cloud computing, later users will be able to access information related to IoT devices running through mobile devices/web via the internet networks (Miller *et.al*., 2015) (Chawda, 2020)

Figure 5. Example of Smart Home IoT

There are ten main products from smart home which are generally offered in retail to consumers (Gulve, 2017). Broadly speaking, IoT smart home devices are used by consumers to meet thefollowing needs:

a. Manage all home devices in one place or one application.
b. Enables flexibility in the use of each device.
c. Increase security at home.
d. Manage the device remotely.
e. Improve the functionality of home appliances.
f. Generate insights related to management in the house.
g. Improve energy efficiency.

Based on the results of research conducted by Cawda (2020), there are several advantagesand disadvantages: (Chawda, 2020)

Advantages:

a. Increased user engagement with their home devices.
b. Software and hardware are continuously being developed by developers so that it is possible to update applications and launch new series of devices.
c. Optimization of technology to support home operations.
d. Reduction of energy waste and other waste.
e. IoT is already equipped with a lot of AI, thus enabling more optimal automationusing existing sensor technology.
f. Improved data collection.

Disadvantages:

a. There is a technology learning curve, where not everyone is used to using smart homedevices, so there is a need for adaptation to the technology offered.
b. The danger of hacking that can threaten security and privacy.
c. Sedentary Lifestyle.
d. The need for additional costs that are not cheap to be able to implement smart home.

Smart home is undeniably able to improve the quality of life for users who apply it, but there are several risks in its implementation, including (Chawda, 2020):

a. Privacy risk: there is a danger from hackers who are able to hack the privacy data of users.
b. Smart home device error: Potential malfunction of the device, especially on devices such as smoke detectors,

and smart gas systems which can be dangerous if a malfunction occurs.

c. People with disabilities: for some people with disabilities, the use of a smart home thatuses a smartphone as a controller can be unfriendly for people with disabilities.

Business to Business (B2B)

B2B implementation of IoT can be seen in various types of industries. The rapid development of IoT can be seen in the logistics and building management industries. The land fleet is one of the most utilized types of fleets in the logistics industry, so monitoringof the fleet is one of the most needed things in this industry (Saghaei, 2016). One of the most widely used tools is the vehicle tra

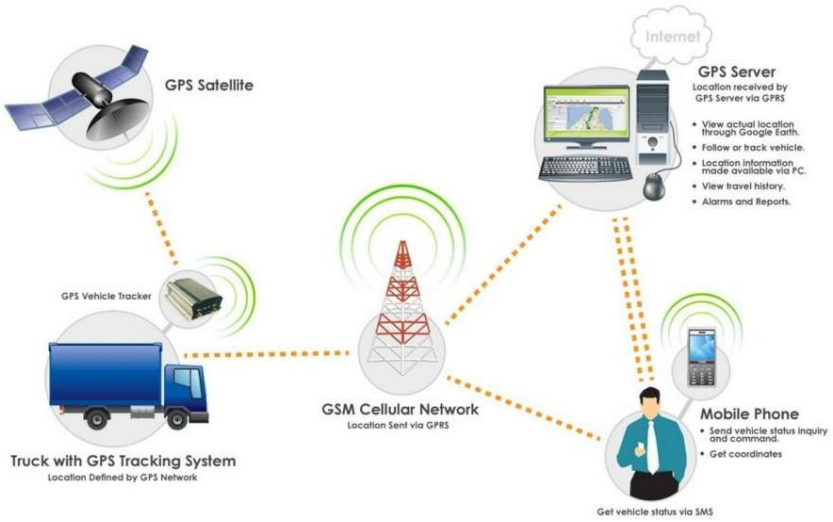

Figure 6. Fleet Management Architecture

The picture above shows the architecture of the GPS tracking system embedded in the Truck. Users will be able to find out the location of the vehicle via a mobile phone device remotely. Through the use of this device, there are various benefits that can be obtained forcompanies that use it, including (Saghaei, 2016):

Advantages:

a. Fuel optimization through route optimization degenerated by this system.
b. Improved supervision to make it easier for management to monitor the conditionof vehicles.
c. Reduction of costs that must be incurred compared to the manual monitoringprocess.
d. Get info on vehicle performance.
e. There is potential to reduce the incidence of driving violations, such as that whichoccurs when a vehicle driver drives beyond a restricted speed.
f. Increased satisfaction of all employees due to transparency.
g. Insights generated by this system can be used by management to support thedecision-making process.
h. Standardization of concept implementation with the aim of improving existingmethods based on existing data.

Disadvantages:

a. Companies need to invest no small amount to be able to implement this system.
b. Connectivity conditions will not always be good at every location, so there is a potential for connection loss so that vehicles cannot be monitored.
c. The process of implementing the technology is generally very difficult for users inthe field to accept, so that the investment spent to install this device has the potential to be not properly utilized by users.

Fig. 3: The latest vehicle position on the map using the proposed native

Figure 7. GPS Tracking Dashboard

The picture above shows one of the models of the dashboard used for implementing IoT fleet management. The above application is a web-based application, so that the monitoringstaff can find out the position and speed of the vehicle (Saghaei, 2016).

Other implementations in building management can be seen from the implementation of smart sensors/smart switches that can turn on and off lights automatically when there are people in the room. The implementation of this technology can improve electricity efficiency efforts, and overall be able to cut costs that must be incurred by building management (Gulve, 2017).

Business to Government

Smart cities are defined by the British Standards Institute as "the effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens". The implementation of IoT in governmentis very visible in the smart city program launched by the government. The use of IoT devices is starting to expand along with the implementation of the government's smart cityprogram, which requires IoT devices to be able to support the program (Pawłowicz, 2020).

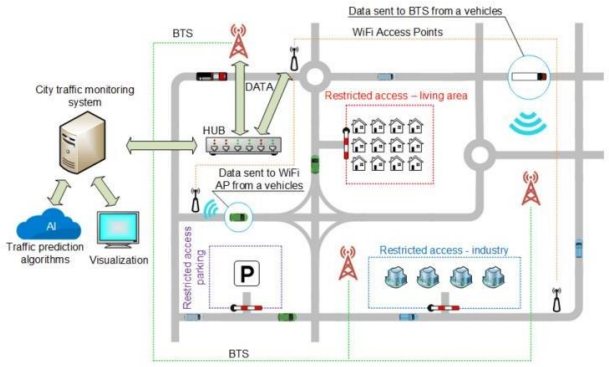

Figure 7. Smart Traffic Architecture

Smart cities are created by integrating IoT devices into a single system to collect data that can be processed to generate insights that are used to make city planning management decisions. In public transportation, one of the IoT devices that is widely used is the monitoring camera & mobility tracker to track the position of public transportation. In addition to being available in public transportation, IoT is also applied to road infrastructureto be able to monitor road conditions and report any act of violation that occurs on the road(Pawłowicz, 2020).

5. CONCLUSION

IoT is now starting to be widely implemented. The convenience and benefits offered by IoT areattractive to industry players. IoT devices are developed in almost all types of segments, from retail, enterprise, SME, to the government segment. However, behind all the advantages and disadvantages of IoT, there are still many challenges in implementing IoT, both in terms of reluctance to spend more, infrastructure that does not fully support IoT, to imperfect regulationsrelated to IoT implementation. The future of the IoT market can still be considered bright eventhough there are still challenges that exist, so that until now developers are still trying to develop IoT.

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